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LADY CYCLISTS IN BATTERSEA PARK, LONDON

LADY BICYCLE RIDERS IN BATTERSEA PARK, LONDON.

"BICYCLING is not nearly so much of a craze in England as here; and the reason therefor, as I figured it out after much interested investigation, is illustrative of a notable difference between the United States and England in athletic and sporting matters," said a wheelman who had just returned from a transatlantic trip. "Because of the superb roads to be found in every part of England, I expected to find the country simply overrun with bicycles. I soon learned that the sport had by no means the general hold on people disposed to exercise or athletics as it has here. It has taken a comparatively greater hold upon the women than the men, which is entirely consistent with my theory. The latter statement is amply confirmed by a visit to Battersea Park, London, where many members of the aristocracy may be seen riding daily.

"Battersea Park is across the Thames, and is not a great way from Westminster and Kensington, so that it is little wonder that it was selected by the leaders of society for the purpose of enjoying their favorite sport. Before the advent of lady cyclists the park was practically unknown to many of the inhabitants of the fashionable West End of London, but to-day the sight presented to view between the hours of ten and one of a fine day is really well worth seeing. The gentlemen ride in trousers instead of knickerbockers, and flannel or all-wool garments are conspicuous by their absence, while the ladies, with few exceptions, endeavor to make cycling keep pace with the fashion, for crêpon skirts of more than ample proportions, balloon sleeves and hats of Brobdingnagian proportions are decidedly in the ascendant.

"One of the neatest bicycle costumes to be seen in the park is of golden brown kersey cloth; the skirt reaches to the shoe tops and is stiffened with haircloth to a distance of eight or ten inches, and it is four yards around. Leggins of the same material as the gown meet knickerbockers of light texture at the knee. The jacket is lined with cream white satin; under this is worn a white shirt waist or a perfect fitting white sweater. A golden brown hat with black quills, tan shoes, and white or brown gloves, and a bunch of violets finish the costume.

"Nearly all of the ladies sit far too low and carry their hands too high, but on the whole their appearance contrasts very well with that of American lady cyclists, who are found in London in considerable numbers during the season.

"During the past three months there has been an unprecedented exodus of America's fashionable people toward the summer resorts of Europe, and it is interesting to note the great number of wheels they have taken abroad to be used in touring in Great Britain and the Continent. No pleasanter way of seeing the sights can be imagined than to wheel from town to town over the magnificent roads of England and France. These American tourists are really missionaries for the American bicycle industry, for though our fashionable people will buy their wardrobes in London or Paris, they invariably take their American wheels with them."

In America wheeling is very popular among ladies, and a journal is now devoted to their interests. The Wheelwoman is published in Boston, and it states that it is devoted to the interest of those who ride the wheel and to the conversion of those who do not.

The bicycle craze has even struck the women of the South and promises to take as complete possession of them as it has of their Eastern, Western and Northern sisters. Richmond women were the first in the South to take to wheeling, and several prominent society women have organized a club modeled after the exclusive Michaux Club, of New York. The Michaux Club is composed of many prominent members of society and they ride under cover during the winter. In Brooklyn the Riding and Driving Club is about to make a large addition to their palatial club house and riding academy to accommodate the members who are cyclists.

On August 20 the Knickerbocker Club, of New York, took a run to Mason's Hotel, on the Brooklyn cycle path, and the occasion was the inaugural ball of the club, which was composed of feminine bicyclists who favor rational dress.

The eighty lighted cycles presented a pretty appearance. The bloomer costume prevailed among the ladies.

We are indebted to the Illustrated London News for our engraving.

MANUAL AND SENSE TRAINING, THE GREAT PROBLEM IN EDUCATION.*

By PETER T. AUSTEN, Ph.D., F.C.S., Professor of Chemistry in the Polytechnic Institute, Civil Service Examiner in Chemistry for the City of Brooklyn.

IN a recent lecture on the subject of "Science Teaching in Schools," I endeavored to explain how important it was to train the young in observation. I claimed that in no way could this necessary training be given them other than by the study of physical science, and endeavored to show that no matter how much drill a child might have in arithmetic, history, grammar and languages, its full powers would not be developed unless it were taught physical science, and that, too, not by books alone, but by actually studying the objects themselves, and by producing and observing the phenomena. I said that all children, without exception, should receive the elements at least of a scientific education, and I also maintained that if they were not taught the elements of science, they would pass through life unable to draw upon a considerable part of their intellectual resource. No one who is a teacher, and who is accustomed to study men in their progress through life, can fail to be deeply impressed by the excellent results which follow where science has been properly taught in the schools; and on the other hand, by the flaws that are observed in those in whose education science has not taken its proper position.

To a visitor from some other world how absurd it would seem should we say to him, "We teach our children how to spell words of which they know not the meaning; how to write, but not how to produce ideas about which to write. We teach them dead languages, and do not give them a working knowledge of their own tongue. We teach them about the past and its history. But concerning the material world in which they live, move and have their being, and on the exact knowledge of which their chances of success and happiness in that world will in large part depend, we teach them little. Even when they grow up, they know hardly anything about hygiene, ventilation and sanitation. The working of their own bodies is a puzzle to them. They don't know what to eat, or drink, or how to clothe themselves. They are sent naked and unarmed out to fight their way in a world of matter and force; ignorant of the pitfalls on every side of them, of the temptations that may allure them, and of the punishment to others as well as to themselves that will follow their misdeeds."

In such a world one needs more than a knowledge of history, arithmetic, and language. One needs sharp eyes which see aright, quick ears which hear true, trained and nimble fingers to execute the commands of the mind with accuracy and dispatch. A practical acquaintance with material things is necessary and adequate knowledge of the causes of their phenomena, so far as it is possible for one to know them. I do not undervalue book training. On the contrary, I say the youth must study books and understand them. But as the child grows, it gets its information and education through its senses. If these senses are not well trained, the progress of the possessor will not be satisfactory. Education by books is good, but it is not everything. From books one gets facts and information; but not the power to observe for ourselves, to test the accuracy of the information, to compare, to judge, to reason. The reader of the book may be of less value to the world than the book, for the book is permanent, easy of access, and useful to many, and that is more than can be said of the ill-trained reader. The fully educated man should be not only a reader of books; he should observe enough during his life to be able to make a book if necessary.

It is not, then, to make scientific investigators out of the young that I advocate a thorough course of instruction in science in schools, but to train and educate their powers of observation, judgment and reasoning. I say more than this, the training and education cannot be given in any other way. Quite apart from the consideration of mental training by science teaching, it is necessary that one should know something about physical science if one is to get any real satisfaction out of this life. No one will deny that some knowledge of the material things and forces is necessary to success and happiness, let alone the necessity of avoiding accident, disease and distress. How little do most people know of these things! How seldom do we find well ventilated rooms, good sanitary regulations, proper hygienic house construction. The visitor from the other world might reasonably ask, "Where do your people learn about themselves, about the world of which they are factors, about their habits of life, principles of morality, and right relations to each other?" To which we might answer, "By hard knocks, by finding that life is intensely earnest, by failure; too little, alas! by success." We might point, also, to the dark shadows that these words throw, and which cover so many broken aspirations, dead feelings and lost hopes. There is the battle field on which we rushed with colors flying, waving our swords and blowing our penny trumpets, until the "dark tower" echoed back the feeble din. Then came at us creatures that we knew not. Huge beasts, crawling reptiles, stinging gnats, and rough men with jagged clubs; they struck us and bit us, broke our swords, split our penny trumpets, trampled our colors in the mire; until disheartened and disabled, we crawled away on sore hands and bruised knees as best we could. Aye, and some stayed on the field. Then turned we back and asked of those who sent us out to do battle, "Was it fair, was it just, not to tell us of these foes and dangers?" But those who sent us answered not.

It may be urged that more bluster is made about the matter than is needed; that after all people get along on the whole quite well, and that education will adapt itself to the wants of the people. This, however, is not so. In the first place, people do not know what they want, and not knowing, do not as a matter of fact get along well. It is only those who study the subject that see where the trouble really lies.

The reports of Dun's Mercantile Agency show that men do not succeed as well as they might. In 1877, investigation showed that $1,800,000,000, or 38 per cent., of the capital reported as invested in 200 of our railway companies, was wholly unproductive to the investors, and the greater part was wholly lost to them." "The actual shrinkage and loss to somebody, on the full value of railway investments in the United States, had been fully 50 per cent." Such an exhibit proves that "in the projection, construction and management of the railway investments in the United States, there has been gross incompetency." In 1870, 50 per cent. "of the wholesale merchants doing business in Chicago had failed, suspended or compromised with their creditors." It has been said that not more than three merchants in a hundred, "who embark in trade end life with success." One writer says that nearly all merchants fail about once in twenty years. Why does the average man fail in business? I answer, he fails for the same reason that I can't speak Hebrew; I don't know the language; and he is ignorant of the facts, principles and causes involved in business. Why does a certain man succeed? As a rule, because he understands the business. It may be said that some men are lucky. Men may make what are called lucky strikes, and pick up nuggets of gold; influence, social position, and accident will do wonders, I admit; but this does not continue. Unless the lucky man has ability, knowledge and energy, his luck will not last.

I have referred to the failures of men. How about the women? Study the statistics of great cities; visit the tenements, and ask if it were not better that some of these struggling, despairing, wretched feminine failures had never seen the light of day? Could a man who had been brought up in a country town undertake, off hand and without experience, to sail a ship in rough weather? He might get ahead on a clear day, with a kind wind to fan him along, but how about the cyclone which he could not foresee? The illustration represents the average boy or girl leaving school and college, and taking hold of real life. They don't know how to paddle their canoes, let alone the handling of a big ship lashed by waves, bumped on hidden sand banks, punctured by submerged crags, beaten by wind and sleet, and lost in darkness. They can't read the barometer, they don't know the signs of the weather or the leeway that the ship is making. They will dawdle on the after deck and read dime novels when the typhoon is grunting in the distance and will soon turn the ocean into a devil's caldron of swirl and screech, and toss their ship over and under the spume and swash like a chip.

It is the mind, carefully educated in realities, that must then come to the rescue; a clear head, and firm hands to hold the wheel. Such a mind commands the forces of nature and makes them obey like well-trained children.

I will go farther, I will leave business and take ordinary life. I say that the average man and woman is a failure. I don't mean every one, I mean the average. Many a one knows it in his heart of hearts that this is the case. Your hopes have not been fulfilled, you are not what you hoped you would be. Your work is mostly done by will power, not by love. You haven't what you want, you don't want what you have. You are a clerk, you want to be a musician; you are a musician, you would rather be a writer; a lawyer, and wish you were a machinist; a teacher, and you would be a preacher. The wife you want you cannot have, the one you have does not want you. You would be this, that, or something else, but you don't know how to be it. So you put Duty on the altar and worship it, and in fact that is about all there is for you to do. I am not a pessimist. Far from it. I simply note what I see about me, as a conscientious observer should do. It is a great thing to be able to see things as they really are, but it is about the hardest thing to do that there is. The average man is not properly educated for the work that he really has to do in this world, and on the successful carrying on of which his efficiency, success and real happiness will depend. To put it more concisely, the average education of a man does not adjust him to his environment. As regards the education of women, the education usually given does not fit them for anything of particular value. In many respects women are potentially equal if not superior to men as factors in our civilization. Pedagogically speaking, they are magnificent possibilities, but rarely practical realizations.

Aside from the knowledge that can be obtained from books and words, that is by printed and oral instruction, and this should include not only printed words but diagrams, pictures, etc., instruction must be given by things themselves. An education must be given in material things, and that can only be given by actually handling them and working with them. Here let me guard against a very common misunderstanding of this subject. Even men of high position in educational circles sometimes curiously misapprehend the idea and object of manual training.

Manual training does not necessarily mean a special industrial education. But this education is of great importance in the growth of a nation such as we are. The industrial schools, wherever they have been established, have done wonderful work. Hundreds, yes, thousands, of young men to-day are actively engaged in remunerative industry who owe their entire education to these schools. No city should be without them. Every city should have these schools, where boys may learn machine work, plumbing, carpentry and the trades in an efficient and practical way, so as to be able to go out and make their living by their hands. How else can a young man learn a trade today? If a wealthy man wishes to aid a town, let him found a trade school. He will find that it will not cost so much; he will find others who will assist; and it will not be many years before the institution will be one of the most powerful factors in the civilization of the town.

Indeed, such small ferments can be started without much difficulty and at small expense. A lady friend of mine tried the following experiment: In a low quarter of our town there was a very low set of bad boys called the dock gang. They were a perpetual nuisance, and, as they were growing older, promised to pass from boyish hoodlums into dangerous criminals. They stole, set fire to sheds, drank what they could get, smashed windows and in every way showed steady and ardent progress in criminal education. This lady thought she would try an experiment. She hired a room in that quarter of the town, had it cleaned, painted and papered, and placed a placard on the door announcing that it was the "Whittling School." She bought a dozen good, strong jack knives, several bladed and of the best quality of steel, several oil stone slips, an oil can or two, and a plentiful supply of wood. She got the names of the boys comprising the gang, and invited them all to meet her at the "Whittling School." Then she hired an ingenious joiner, and told him to show the boys how to use a jacknife in every way that a jack knife could be used. Well, the boys came; not one of them had even washed his face. They came to have fun and raise a racket. They stayed and forgot the racket under the influence of the jack knife in the hands of the ingenious joiner. The dock gang now disappeared, and in its place instead there was evolved a class—not a gang, but a class—of young men—not hoodlums any longer, but young men.

Out of a board, these boys seem to be able to make almost anything with jack knives. And the teacher, by the way, the joiner, carries his head quite high when he talks about his "class." The teacher—he will be a professor next, I suppose—soon found that the limit of the jack knife was reached. A kit of tools was supplied and the boys, or perhaps I should say the students, studied the plane, the chisel, the gouge and other implements. Further, some of these boys developed unusual skill and ability, and were able to go to work for a good living. Indeed, I hear that one of them has begun to invent.

So a jack knife turned the prospective criminal into a valuable man. Carlyle was right when he said, "Man without tools is nothing; with tools, he is all." There is a mistaken idea that, to accomplish anything great in this world, one must needs have a large sum of money, powerful adjuncts, influence and what not. But the fact is that individual effort is, after all, the surest force there is. Probe every great movement,

* A lecture given before the Bridgeport (Conn.) Scientific Society.

enterprise or undertaking in this world, and sooner or later you will find an active man whose brain and energy constitute its mainspring. So long as the individual is idle, reforms must be undertaken by corporations, but if the individual is active, reforms go of themselves. How many persons there are that could start and maintain a whittling school, a cooking school or some such useful institution, and run the whole thing, be president, faculty, instructors, all in one? A few months would give surprising results.

Let me return now to that most important distinction between manual training, which is educational, and industrial education, which is learning a mechanical art. Almost all the opponents of manual training in the public school start out from the false premise that it "has for its aim the education of children to be mechanics." Against this phantom there have been directed much wordy thunder and sarcasm, and there have bloomed many of what Huxley calls the "pernicious flowers of rhetoric."

Then it has been urged that manual training would break up home industry. This statement is false. The recent distribution of electric power is making home industry more possible than formerly. All such arguments are really directed against premature professional or technical training, which has nothing whatever to do with manual training. Note this distinction, for it disposes of most of the opposition at once. Those who wish to acquaint themselves with the many objections raised to manual training, and how they are easily disposed of, should read the translation of Seidel's excellent essay on industrial instruction.

Bacon said that "Education is the cultivation of a just and legitimate familiarity betwixt the mind and things." To which might be added by way of method, the injunction of Comenius, "Let those things that have to be done be learned by doing them." While education is now considered a far more complicated undertaking than in the days of these thinkers, their words are true and forcible. Manual training has not for its object the education of the young to be mechanism, but is intended to train the senses and the hands and the members, and through these the mind. It is the development of object teaching, the conclusion of the kindergarten. It is the education in the properties, working and applications of material things, and the training of both body and mind by the study of these material things. Our boys and girls have a right to the knowledge that belongs to our time, not alone to a portion of it, but to as much of it as they can master. We have no right to restrict the young to certain fields of knowledge, and to exclude others of equal importance. I claim that the first step in education and the last should be the education of the senses and the members. Not that the steady development of the mind should be neglected, far from it. I wish that half the so-called education of to-day did educate the mind, and practice and sharpen the ability to reason correctly, instead of simply wearying the memory, and making the mind a dumping ground of indigestible facts, from which the student can assimilate but little real intellectual nutriment. If history cannot be taught so as to let the philosophy of history appear, what is the use of history? Why coop up the children in the cemeteries of the past, when they can play in the flower-speckled gardens of the present? We are making plenty of real history in this country. Why spend years on a dead language, if good reasons cannot be presented for doing so? We can get the ideas of the old writers, if not their charm of form, from translations. Emerson was not astray when he advised their use.

The theory of manual training has been well expressed by Ham in his book on the subject. "In the process of education," he says, "the idea should never be isolated from the objects it represents: first, because the idea, being the reflex perception or shadow of the object, is less clearly defined than the object itself, and second, because joining the object and the idea intensifies the impression. Separated from its object the idea is unreal, a phantom. The object is the flesh, blood, bones and nerves of the idea. Without its body the idea is as impotent as the steam that rises from the surface of boiling water and loses itself in the air. But unite it to its object and it becomes the vital spark, the animating force, the Promethean fire. Thus steam converts the Corliss engine—a huge mass of lifeless metal—into a thing of grace, of beauty and of resistless power. Suppose the teacher, for example, desires to convey to the mind of a child having no knowledge of form, an impression of the shape of the earth; he says, 'It is globular.' The child's face expresses nothing, because there is in its mind no conception of the object represented by the word globular. The teacher says, 'It is a sphere,' with no better success. He adds, 'A sphere is a body bounded by a surface, every point of which is equally distant from a point within called the center.' The child's face is still expressionless. The teacher takes a handful of moist clay and moulds it into the form of a sphere, and, exhibiting it, says, 'The earth is like this.' The child claps its hands, utters a cry of delight, and exclaims, 'It is round like a ball!'

"This illustrates the triumph of object teaching, the method alike of the kindergarten and the manual training school. As the child is father to the man, so the kindergarten is the parent of the manual training school. The kindergarten comes first in the order of development, and leads logically to the manual training school. The same principle underlies both. In both it is sought to generate power by dealing with things in connection with ideas. Both have common methods of instruction, and they should be adapted to the whole period of school life, and applied to all schools."

In an address at the laying of the corner stone of the school for primary, superior and professional instruction at Paris, Jules Ferry, the late French Minister of Public Instruction, said: "We desire to ennoble hand labor. We have written this motto in large letters upon our programme, and we have chosen the surest, indeed the only, means of securing the recognition of the nobility of hand labor, not only from those who exercise it, but also from society as a whole. We have introduced hand labor into the school itself. Believe me, when the plane and file are accorded their place of honor by the side of the compass, the map, and the text book in history, and when they become the objects of rational and systematic instruction, only then will a great amount of prejudice die out, and much of the spirit of opposition vanish away. Social peace will find a place upon the seats of the elementary school, and Harmony, with her beaming light, will illuminate the future of the nation."

Seidel concludes: "Truly, if this has been declared by the leader of public instruction for a great nation, and if, as we see to-day in France, the word has become flesh, then this matter cannot be arrested by a few apt phrases of schoolmen, but with or without the mediation of official pedagogy, must make its way through the educated world." Ham says that "The true definition of education is the development of all the powers of man to the culminating point of action; and this power in the concrete—the power to do some useful thing for man—this must be the last analysis of educational truth." The idea is not new, for it will be found in the writings of Bacon, Rousseau and Spencer, and in the systems of Comenius, Pestalozzi and Froebel. Such a system of education may be called the natural system.

Kopp remarks, and the point is an interesting one, that in the ancient times, manual labor and work of all kinds were matters largely relegated to slaves, and were consequently looked down upon. Science and art were divorced. A high ideal or even a proper respect for scientifical work or manual or sense training will rarely be given by classical study. Indeed, of those who study the classics only, but few ever find out what really caused the downfall of the ancient civilization. A classical scholar has too often a most thoroughly antique idea of what physical science really is. Neither does he understand or appreciate manual training and technical education, and what they are. He does not seem to understand the causes of action and change, nor grasp the real significance of what takes place about him.

Emerson said, "We are students of words; we are shut up in schools and colleges and recitation rooms for ten or fifteen years, and come out at last with a bag of wind, a memory of words, and do not know a thing. We cannot use our hands or our legs or our eyes or our arms." George S. Murrain put the matter more strongly. Said he: "Up to the day when I took my diploma, there had been, I may say, nothing in my education that required me to use my eyes, or any of my senses or perceptions, for any purpose save to read the printed page. I had been taught no knowledge, and no means of acquiring knowledge, except from books. Of knowledge at first hand, I had learned absolutely nothing. The whole habit of personal observation of the phenomena and processes of the material world was left out of our education entirely. That omission for myself, I unspeakably lament. History and literature I can to some extent pick up as I go along; but I shall never get that intelligent, sympathetic working knowledge of my physical environment for which the aptitude and instinct might have been easily gained when I was fourteen or sixteen. I was given, indeed, some of the keys to the riches of literature, but of things, I never learned the alphabet. I acquired no use of my perceptions save with my eyes to read the printed page, and with my ears to hear my instructor's voice." These are quiet and very significant words, not impatient ones. I believe that there are many men and women who can say the same. Understand that I do not decry the merits and worth of classical studies or of any study. I simply hold that they should not be given a greater prominence than they deserve.

Dr. Youmans said very aptly: "The human mind is no longer to be cultivated merely by the forms or arts of expression. The husks and shells of expression have had sufficient attention; we have now to deal with the living kernel of truth. Under the old idea of culture, a man may still be grossly ignorant of the things most interesting, and now the most important to know. Modern knowledge is the most perfected form of knowledge, and it is no longer possible to maintain that it is not also the best knowledge, for that cultivation of mind and character which is the proper (i. e. the highest) object of education." In another place he says: "The old method (of education) occupied itself mainly with the study of language; the new method passes beyond language to the study of the actual phenomena of nature. The old method has for its end lingual accomplishments; the new method, a real knowledge of the characters and relations of natural things. The old method trains the verbal memory, and the reason, so far as it is exercised, in transposing thought from one form of expression to another; the new method cultivates the powers of observation and the faculty of reasoning upon the objects of experience, so as to educate the judgment in dealing with the problem of life. The old method left uncultivated whole tracts of the mind, that are of supreme importance in gaining knowledge of the actual properties and principles of things which are fundamental in our progressive civilization; the new method begins with the systematic cultivation of those neglected mental powers."

I might quote many other authorities in a similar strain to show how deeply this problem of educating the young, so as to make them really competent to enter into the struggle of life, and be of real value in our civilization, is occupying the attention of thoughtful men, but these are sufficient to indicate the trend of thought on the matter.

Give us, then, fuller knowledge of the world we live in, both material and mental. Give the young a thorough training and education in physical science; and now let me repeat it, give them a good manual training as well.

Should girls have manual training? Why not? The inference is the affirmative. Let me say at the start that when I say the young I do not discriminate between the sexes. A girl deserves as thorough an education as a boy. I have read a great deal, studied a great deal, observed a great deal and experimented a great deal on this matter, and all the conclusion that I can reach is that if you exclude anything from a girl's education, it usually turns out that it was the one thing she ought to have had. In the laboratory I have taught both women and men; I cannot see much difference between them. I find very stupid girls at times; and the only objects which can compare with them at all are the stupid boys. Again I meet girls that are so bright that I can only compare them to bright boys.

I recollect the governor of one of our most prosperous States once wandered into my laboratory and was much interested in the explanation I gave him of how we taught the young men chemistry, how they had to make the experiments, observe and record the phenomena, and then pass by degrees into accurate work, using the balance and weighing down to the thousandth of a grain. It was all new to him; the boys working in their acid-eaten old aprons, the blackened ceiling, the remains of many a "bust" on the walls, the unearthly smells, the roar of the furnaces, the swinging needles of the balance, the quick handling of the apparatus; every action full of interest and energy. "It's just like old Squeers," he said. "Tell a man to spell winder, and then make him go and clean it." And when he left me he shook hands and said with great energy, "Why, you are a regular old Squeers!"

Now, how can this education in material things be given? What are the links between us and material things? What bridges the great gulf between the aboriginal savage and the civilized man? They are the hand tools, the ax, the saw, the plane, the hammer, the square, the chisel, the file, the knife and the awl. When automatic, they are machines, but the machine is only a materialized idea. These are the links between the man and the natural world, and if anyone of them is not there, the bond between the man and his environment will be just so much the weaker.

There may be some who consider these tools as not worthy of serious attention, and yet I think when the matter is carefully considered this opinion will not be held. The pen and pencil are not of more importance than these tools; in fact, they too might be called tools in one sense. The pencil expresses ideas in words or by sketches, while the chisel and the plane express ideas in wood. Here I repeat that I am not advocating manual training with a view to making mechanics who shall push the plane by the day for a living. Manual education is to give the power of expressing ideas, not by words or drawings, but by material things. The distinction is the soul of the whole thing. As Dr. Belfield well says, "Here is the mistake of those who would degrade a manual training school into a manufacturing establishment. The fact should never be lost sight of for an instant that the product of the school should be, not the polished article of furniture, not the perfect piece of machinery, but the polished, perfect boy. The acquisition of industrial skill should be the means of promoting the general education of the pupil; the education of the hand should be the means of more completely and more efficaciously educating the brain." Dr. Belfield also says that in his opinion, "one hour in the shop of a well conducted manual training school develops as much mental strength as an hour devoted to Virgil or Legendre." In this connection I will quote another authority, Mr. John S. Clark, of Boston, who draws attention to the fact that the schools educate automatically, training the absorbing powers of the brain, and failing to cultivate the faculties of assimilation and recreation, and neglecting almost entirely to develop the power of expression. He says, "Studying the functions of the brain, we find that in our educational purposes it may be likened to an organism with a threefold form of working, an organism with a power of absorption, a power of assimilation and recreation, and a power of expression, a giving out. The form or character of a brain is measured entirely by its expressing power, by what comes out of it. Examining a little closer, we find that the brain absorbs through all the five senses, while for expressing purposes it makes use of but two of these senses, or rather of but two of the organs of these senses—the tongue and the hand. The simple fact is that our education is not broad enough on the expressing side of the brain, that too much attention has been given to the absorbing side of this organ, that no adequate provisions have been made whereby it can discharge its power in work connected with the industries. A more perfect education will then be to give as studies, reading, mathematics, geography, grammar, history, language, physiology, literature, natural history, theoretical sciences, practical sciences. Then, as means of expression by the tongue, speech, and by the hand, writing, drawing, and the manual arts."

As matters now stand, the schools fit the student to some extent for certain professions, as law, medicine, theology, science, bookkeeping, etc. But the public school system does not, except in a few instances, fit the average boy for active work in the world. The vast body of mankind cannot be professional men, but producers of material things. They must work on the industries. A general education should then be an education not merely to educate a few for confined fields of work, but it should establish a broad and solid foundation, on which the boy's mind may build any kind of home it wishes to live in. Is he to become a lawyer or a preacher or a scientist? The manual training that he will have had in such a general education will be of as great value to him as to the boy who becomes a mechanic or a farmer. What is the average graduate of a high school fitted for? He can read, cipher, write and draw a little, but is he developed and trained in any way commensurate with the possibilities that are in him? How far has he been taught to know his own powers, to know what he is good for? Of the immense number of ways in which he can be of value in our civilization, how many has he been shown? If we compare a boy to a mine that contains more or less valuable metal, I should say that the school system does not develop the mine. It does not discover the lodes of precious metal, its shaft and galleries are not cut in the right directions, the little metal that is extracted is not refined, the processes are crude and wasteful, and not seldom the mine is allowed to fill up with water and choke damp. Again there are many mines, rich in precious metal, yes, and in gems, that our present pedagogical engineer is unable to work. He does not even get below the dirt layer, he fails to discover the treasure and to make it available to the world.

The introduction of manual training into the school system would of course involve a considerable expense, and means would have to be found for meeting it. But if it is a necessity, then it is our duty to the young to see that it is provided, for as I have said, the young have a right to the knowledge of their day.

We see to-day vast upheavals in our civilization.

Great sums of money are wasted by the laboring classes in strikes and other foolish attempts to impede or resist the inevitable progress of mechanical methods. The lower classes are ignorant and improvident, and hence poor. As Prof. Woodward writes: "The public schools have no funds to spare; salaries are still too low, and the demand for extensions outruns the supply." As Col. Jacobson has said: "The alternative before you is more and better education at greater expense; or a still greater amount of money wasted on soldiers and policemen, destruction of property, and stoppage of social machinery. The money which the training would cost will be spent in any event. It would have been money in the pockets of Pittsburg if she could have caught her rioters of July, 1887, at an early period of their career, and trained them at any expense just a little beyond the point at which men are likely to burn things promiscuously. It is easier and better and cheaper to spend our money in training good citizens than in shooting bad ones."

It might be argued that the courses of study are at present overcrowded, and that there is no time left for taking up any new studies. This was the cry raised when science first began to be heard from. It was said there is no time for it. But after a while it was found expedient to make time for it by cutting out other and less important studies. If it comes down to whether a boy has only the time to learn what he should eat in order to get the most life out of his body, or to learn to read a Latin poem, no matter how exalted its sentiments may be, I say the former knowledge is the more important, and if he cannot learn both, let him throw over the Latin. If the opponents of scientific education wish to fight the battle on the ground of time, they will get very badly worsted. If in the present schedules of studies there is no time for manual training, then some of the studies must be eliminated. That is a simple solution and a practical one. The present system of education may be likened in value to a certain man who bought a fine boiler, fed it with water, stoked it with coal, and kept up a high steam pressure for years, until the boiler finally wore out and was sold for old iron. But as he had no engine or means of utilizing his steam, it was a question among his friends as to what good he had done, or of what use was his well fed and carefully stoked boiler, since its power was not rendered available by means of an engine. He would better have spent the same money on a smaller boiler with an engine attached; producing less power, but making it all available. The subjects that stand in the way of manual training have got to go, just as those subjects that stood in the way of science had to go. The intellectual value of manual training is so great, however, that even if less time be given to certain other subjects, owing to the increased acuteness of the student's mind, as great, if not greater, progress will be made in them. Let that not be overlooked.

What departments should be included in manual training? The organization of the departments and the extent to which the work in each is carried will of course depend on the size of the institutions and the amount of the available funds. There is no doubt, however, that if a department for manual training is introduced in a school, it will grow rapidly and push its way against all obstacles.

First of all there should be the drawing room. Here both geometric drawing and free hand drawing should be taught as a means of expression. This branch of manual training people know something about, and can understand to some extent its uses. Says Mann: "The value of drawing as an educational agency is simply incalculable. It is the first step in manual training. It brings the eye and the mind into relations of the closest intimacy and makes the hand the organ of both. It trains and develops the sense of form and proportion, renders the eye accurate in observation and the hand cunning in execution. Drawing is a language—the language in which art records the discoveries of science. It is not German, it is not French, it is not English—it is universal. The face of the student exhibits vivid flashes of intelligence as the picture reveals itself under his hand. Each line is a word, an angle completes the sentence; with a curve and a little delicate shading we have a paragraph."

Then there should be the carpenter's workshop. Here are taught the properties, nature and applications of various kinds of woods, where and how the trees grow, how they are felled and transported; in fact, the history, science and uses of wood and the use of the tools used in working wood. All sorts of devices are worked in wood. "The lesson proceeds by the usual laboratory methods employed in teaching the sciences; the class learns the thing to be done by doing it. The students are at their best, because the lesson compels a close union between the then great powers of man—observation, reflection and action. No student seeks aid from another, because such a course would be impossible without the knowledge of the whole class. A feeling of self-reliance is thus developed, the disposition to shirk repressed, and a sense of sturdy independence encouraged and promoted."

Next in order comes the wood-turning workshop. As before, the student is taught the history of the art, the evolution of the lathe and its tools, the effects of these tools on civilization, how materials are worked on the lathe, and all the tools and mechanical operations pertaining to this art. Understand here, as heretofore, that "the true purpose of education is the harmonious development of the whole being. The purpose of this turning laboratory is to educate boys, not to make turners of them. In the midst of the whirl of shafting and wheels, with a keen-edged tool in his hands, the student no longer thinks merely of becoming an expert turner; he thinks of becoming a man."

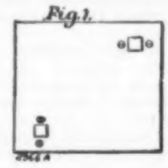
Next comes the founding laboratory. Again the student is instructed in the history of this art, and he will find here, as in other arts, wide application of his classical studies if he wishes to go into the matter. The bronze castings from the ruins of Egypt, Greece and Assyria, the cast statue of Praxiteles, the brazen bulls of Babylon, the writings of Herodotus, the great bells of China and Russia, Vulcan, the God of Fire—why, here is material for real enthusiasm in the student for further knowledge of what has been done in the art he is now studying. The boy will forget his marks and dive impatiently into books for information. He wants to know; not merely to be able to answer his teachers' questions, but to satisfy his own inquisitiveness. He studies the metals, their properties, how they are cast, how the moulds are made. I doubt if there is a better way to start up a real enthusiasm for classical history than to put students in actual work with the metals. He will get also an idea how "through all the early ages the brand and scorn of slavery adhered to labor, while the arts, the products of labor, were so often deified."

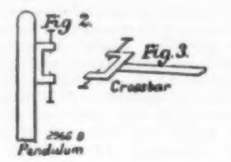
Next comes the forging laboratory. Here again is the course of instruction carried on in the same way as in the preceding departments; drawing, bending, welding, tempering, hardening and all the operations, tools and mechanical appliances of forging are studied.

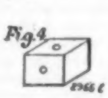
Next and last comes the machine tools laboratory. This indeed is a wonderful place. The student is first educated in chipping, filing, and fitting, and then begins with the machine tool lathes, drills, planers, and all the innumerable appliances used in this work. He is dealing with great thought in metal. The automatic lathe works like an intelligent slave, and the planer runs back and forward with unerring precision. The student marvels at the powers that he has learned to command. He watches the tool do the task he has assigned it, and thinks what he may do one day. Such a boy will be a power in his community and in time in the world. This education has trained not only his hands, but all his senses. He sees exactly, he hears accurately, he can taste and smell with precision. His senses are keen, quick and alive. He observes rapidly and accurately. He does not misjudge. He picks out at once the valuable from the worthless. He knows his own powers, and his own weaknesses. Happy is he who has that latter knowledge; his senses have been thoroughly trained, and he goes forth a man equipped for work. The chances are enormously in his favor, that whatsoever he may undertake will be a success, whether he becomes a mechanic, an artist, or a preacher.

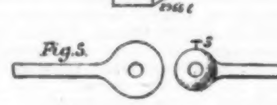
And as to practicality, I am not spinning cobwebs. I am advocating nothing that is not done, and that too with success. The St. Louis Manual Training School, the Chicago Manual Training School, the Toledo Manual Training School (for girls), the Russian industrial schools and many others can easily be cited.

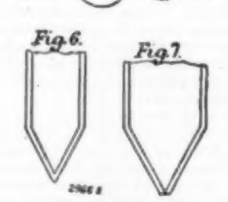
The more one studies this subject, the more important does it appear. What is demanded, and what must eventually come, is an education that shall develop every power, and train every sense and member. The individual must be adjusted to his environment, and unless his senses are trained to act intuitively to their utmost efficiency, and his ability to express and to produce his idea is developed to its fullest extent, I maintain that the young man will never attain his maximum efficiency in the world. The demand and the opportunity for a man who can express ideas only by his pen, and who is acquainted with things only by reading about them, is daily becoming less. His chance of success will never be as great as he has a right to expect; he will never be of the value to the world that his organization of body and mind would enable him to become if he is properly and thoroughly educated. In the long run the average man takes out of life not more, if as much, as he puts into it. The less a man puts into the world, the more will he be dependent on the work of others. The inefficient must be supported by the efficient. We must train and educate the young so that they may not be able only to absorb knowledge, but be able also to express, apply, produce and make knowledge. In other words, they must be educated so that their powers of absorption and expression shall be developed to the utmost, and so that their entire value may be realized by the world. So far as our knowledge makes it possible to do it, manual training is intended to fit them for actual life.











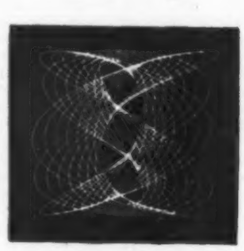


Fig. 8.

THE SYMPALMOGRAPH.

THE SYMPALMOGRAPH.

By Charles E. Benham.

There is nothing in the least new about the compound pendulum, of which so many forms have long been well known. There is no need, therefore, to recapitulate the history of the invention and its many developments, nor even to describe what is so generally familiar. At the same time a few practical hints upon the construction of a simple ordinary form may be of interest to some of your readers who are, perhaps, not in possession of information which will enable them, for a small sum, to construct the instrument for themselves. Without any further preface, therefore, I will give such particulars as are necessary, and trust they will enable those desirous of experimenting with the sympalmograph to do so.

The table must be not less than 3 ft. 6 in high, the top being 2 ft. square. The legs must be fairly stout, and joined by crossbars to insure steadiness. It is better if the legs can be screwed to the floor to secure further stability, and care must be taken that the crossbars are not placed so as to come in the way of the pendulums. Near to two corners of the top, diagonally opposite each other, the holes are cut for the pendulums, for which may be utilized good straight broomsticks. Six or seven inches from the top of the stick a steel knife edge is thrust through at right angles to the rod, and the projecting ends of this rest in the bevels of screw heads filed V-shape in the center and screwed into the table on two sides of each of the holes in the table top. The screws should be placed so that the two pendulums swing at right angles to each other, Fig. 1.

Along each broomstick glue a tape measure to mark the height of the weights in inches, the scale starting from the level of the knife edge. The weights are easily cast in lead, and may be cylindrical, with a hole in the center a trifle larger than the broomstick, so that they may slide up and down on it. A hinged iron collar, with horizontal top and thumbscrew to make it clamp the rod, acts as a rest to support the weights at any required height.

The above instructions having been carried out, we shall have a table with two heavy pendulums swinging at right angles to each other, and capable of adjustment to various lengths so as to give different periods. The heavier the weight, the longer, of course, will the pendulum keep swinging. Eight or nine pounds will suffice for our purpose. We have now to record the combinational results of these motions.

For this purpose we must unite the projecting top parts of the pendulums by two jointed crossbars. These must be fitted with universal joints, of which there are several forms. In my own case the attachment to the pendulum is made with an arrangement of which the following is a description:

Two pointed screws set in brass are attached vertically to the side of the pendulum (Fig. 2), and a similar arrangement is fixed horizontally to the end of the crossbar (Fig. 3). The four points are made to nip four sides of a little brass cube slightly punctured to receive the points (Fig. 4). In this way we have a simple universal joint adjustable by the screws, and subject to very little friction. The other ends of the crossbars are jointed together, one terminating in a pierced brass ball and the other in a concave cap, also pierced, and fitting on top of the ball (Fig. 5). Through the pierced ball the pencil or pen is placed vertically, and held tight by the screw, s, and the apparatus is then nearly completed.

The making of the pen requires a little practice, but the knack soon comes.

Draw out a glass tube of small bore but thick glass to a fine point, seal this point in a flame, and the appearance magnified will be as in Fig. 6. Grind now the point on a hone with water until the hole is just reached, examining the tube with a magnifier from time to time as the work proceeds and grinding carefully to prevent going too far. At last a tiny aperture will be reached, and the appearance magnified will be as in Fig. 7.

Small as this hole is, the line which the pen will describe when full of ink will not be a fine one. It will be as thick as the glass point, not as the hole. We must, therefore, carefully grind away the sides of the point on the hone till our pen is sharp. Of course, this is done without enlarging the hole.

Now put the pen point into a bottle of Indian ink, or any limpid colored fluid, and draw the liquid into the pen by suction, and fix it vertically in the hole in the brass ball. But it should be first mentioned that each crossbar must be counterbalanced by a projecting bar stretching out behind the pendulum, with a little pan at the end for weights, so that the pen may fall as lightly as possible on the paper. To the bar with the ball must also be attached a thread leading up to a catch fixed above the table, and suspending it until the catch is unloosed, and the pen allowed to fall on the paper. This arrangement is easily made with a little kind of gallows rising from the side of the table. One of the pendulums is, of course, kept at a fixed length—39 in. is convenient, as being approximately the length of a seconds pendulum. If the other is at 39 in., the two together describe the spiral figure of unison, and by raising the weight we find by experiment the distances which give us period ratios of the small numbers—2 to 3, 4 to 5, etc. We shall not be able to shorten our pendulum sufficiently to get the ratio 2 to 1, but by placing a heavy weight on the top of one pendulum, on the principle of the metronome, we can make it oscillate very slowly, and can then get ratios up to 1 to 7.

A fine needle in a cork fixed in a glass tube will give us more perfect figures than a pen if we trace on smoked glass, previously smeared with rectified petroleum. Brush the petroleum over the glass, and then hold carefully in the flame of a candle, moving the glass about to prevent the heat breaking it. In a short time we shall have a surface of dry carbon per-

fectly opaque, into which the needle will bite beautifully. The smoking should always be done with a candle, and not with camphor or a lamp, for, though more tedious, this plan admits of much more perfect lines. With the needle and the smoked glass magnificent lantern slides may be prepared. They must be protected by another piece of plain glass with a strip of thin card at the edges between them to prevent rubbing. The diagram, Fig. 8, is made from one of these slides, but it is impossible to reproduce the full beauty of the lines by printing.

In order to reproduce a figure exactly, a system of electric starters has been exquisitely carried out by Mr. George Joslin, of Colchester. He can thereby start his pendulums in any phase, and reproduce the effect exactly as often as desired. For practical purposes, however, it is sufficient to lay a block of wood on the floor and draw the pendulums up to it, letting them go together. To reproduce the pattern, it is only necessary to repeat the operation. With a little practice it is easy to let one go an instant in front of the other, and obtain any required phase of the pattern.

When two patterns are described similar in period but slightly differing in phase, they give extremely beautiful effects of relief in the stereoscope. On the smoked glass especially the stereoscopic results are most fascinating.

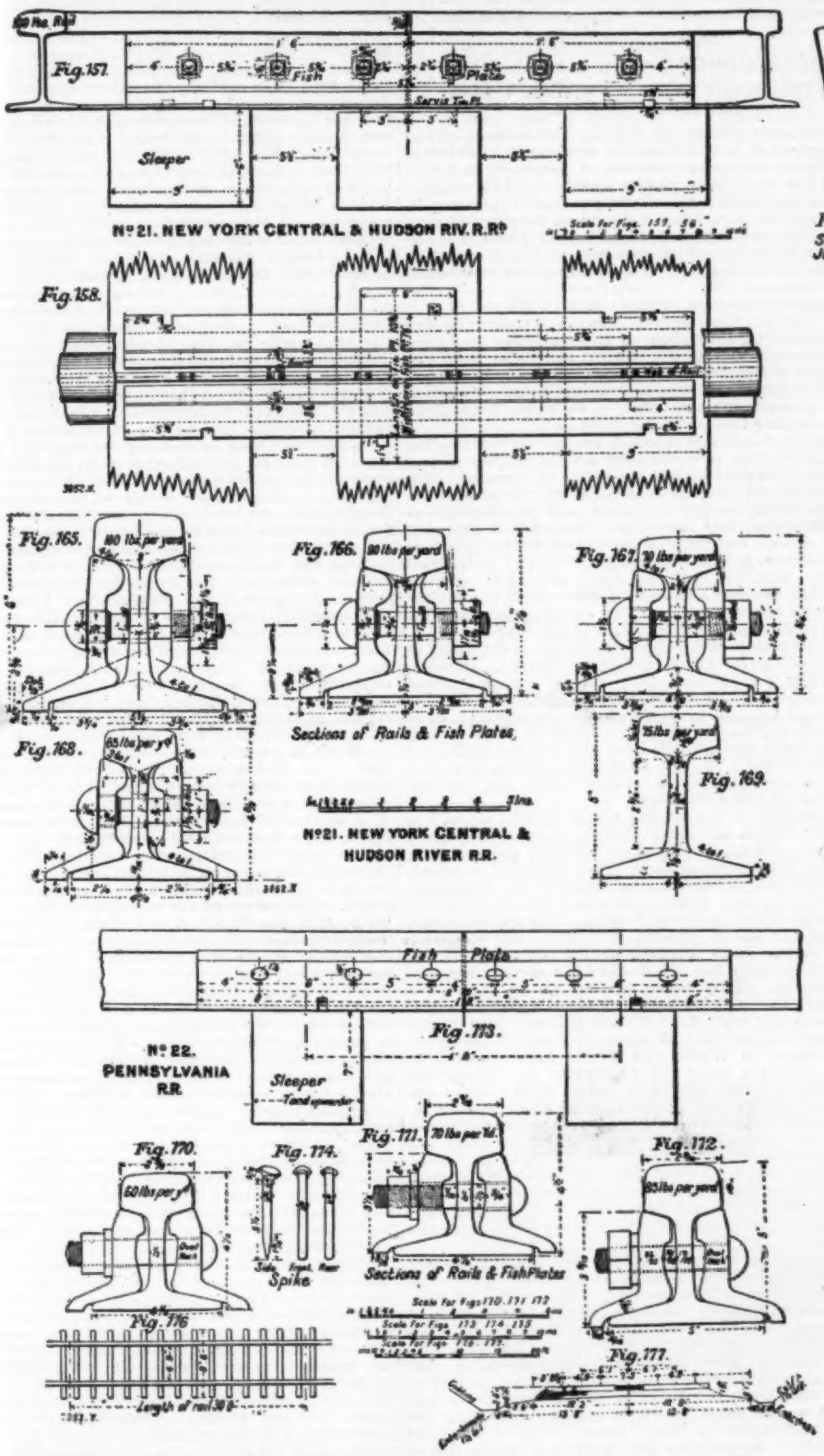
Numerous other modifications might be mentioned, but they are only such as will occur to any experimenter.—Engineering.

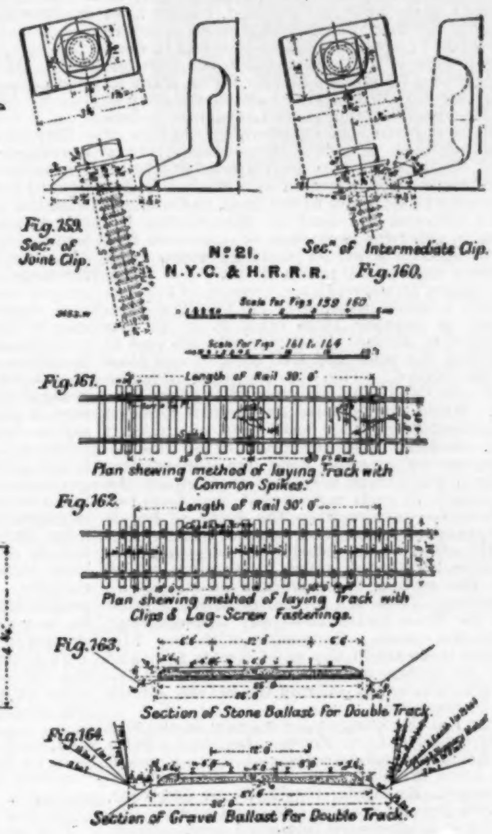
HEEL tips are now being made of aluminum, and are, we hear, coming largely into use in this country. It is claimed that the leather is better protected than in the ordinary manner, and that the tips have the advantage of not slipping on wood pavements.

THE NEW YORK CENTRAL AND HUDSON RIVER RAILROAD—STANDARD TYPES OF PERMANENT WAY.

FIVE types of rails are in use on this line, all of Bessemer acid steel. The rails are not subjected to any bending tests, but every heat is analyzed for carbon, and at least two complete analyses are made each day. The following is the standard specification :

	80 lb. Rail.	100 lb. Rail.
Carbon	0·55 to 0·60	0·65 to 0·75
Silicon	0·10 " 0·15	0·10 " 0·15
Manganese	0·80 " 1·00	0·80 " 1·00
Sulphur	0·069	0·069
Phosphorus	0·060	0 060
Rails are rejected with less carbon than	0·55	0·65
Rails are rejected with more carbon than	0·60	0·75
Tensile strength	49 to 58 tons per sq. in.	
Extension	6 to 12 per cent.	





STANDARD TYPES OF PERMANENT WAY—NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

The following is a list of the rails used, the weight of fishplates, and the area of bearing on sleepers :

Weight of Rail. Pounds per Yard.	Weight of Fishplates per Pair. Pounds.	Bearing Area on Sleepers. Square Inches.
65	54	40 15
70	58	41·625
75	64·5	42·75
80	64·5	45
100	80	79·5

The rails are attached to the sleepers by four clips and screws on each side of joint, and, as intermediate fastenings, by two screws 5 in. long by ⅞ in. As regards wear, three stages are required. The minimum wear is on a level straight line, and 65 lb., 70 lb., and 75 lb. rails ; 6 to 8 per cent. reduction in weight is usually reckoned on before the track becomes too rough. Medium wear is on gradients and straight track ; here renewals take place after a loss of from 6 to 10 per cent. Maximum wear is on incline combined with curves, and the rails are renewed when the outer rail of the course has from ⅜ to ½ in. side wear, while the vertical wear is hardly half as much.

The sleepers employed are oak, yellow pine, chestnut, yellow cedar, hemlock, and tamarack ; they are 8 ft. long by 9 in. by 6 in. The bottom ballast is from 4 in. deep of broken stone, with 12 in. of crushed stone, gravel, or slag. The ballast is laid level with the top of the sleepers.—Engineering.

GLASGOW HYDRAULIC POWER SUPPLY.

RATHER more than two years ago the construction of hydraulic supply works was begun in Glasgow, parliamentary powers having been obtained a year before. These have now been completed at a total cost of about £60,000, and were formally inaugurated by Lord Provost Bell and the Glasgow Corporation Water Commissioners on the 30th of June last. The object is to supply water at a pressure of 1120 lb. on the square inch, as against 50 lb. to the square inch in the ordinary water pipes, for the supply of the hydraulic hoists and presses in the city. With a water supply at the high pressure stated, much unnecessary consumption will be avoided, an important consideration from the Water Commissioners' point of view, while, of course, there will be a great saving effected to the consumer. Mr. Gale, the water engineer of the city, calculates that a proprietor whose hoist supply costs him at present £70 will be supplied at the rate of about £40 by the new power.

The use of hydraulic power in cities was first proposed in 1802, the first experiments being made in Dublin. Not much more was done until about forty years afterward, when Sir William Armstrong launched the idea of the hydraulic press. Works were laid down in Hull in 1874, and in 1882, 1883 and 1884 works were established in London, where they have proved to be of great public utility. In London there are seventy-five miles of mains, with a pressure of 750 lb. on the square inch. The number of machines working from these mains is 2300, bringing in a revenue of £50,000. In these circumstances it was not to be expected that the "second city" of the empire would long remain without the immense facilities which hydraulic power—for special purposes undoubtedly supreme—confers upon large commercial and industrial communities.

Originally a private company intimated its intention of supplying the needs of the city, represented mainly by some 600 hoists and 100 hydraulic presses scattered over the city's area, but they relinquished the project when the Water Commissioners of the Corporation made it known that they themselves had resolved to enter upon the undertaking. This ended the matter so far as private enterprise was concerned, as it was clearly realized that none but a very strong commercial company could have carried out the scheme to a satisfactory issue. Independently of the main items of cost—the site, the buildings, the machinery, pipes and work—there was the question of way leave for pipes through the streets. The city's authorities have always strictly conserved their rights and privileges in this connection, and would not lightly have given any company permission to open up the ten miles of thoroughfare through which the pipes extend.

There can be no doubt the Water Commissioners of Glasgow have taken the right course in introducing the system themselves, complications being thereby avoided, and economy of maintenance secured. In laying out the scope of the works and determining their capabilities, Mr. Gale has made allowance for a great development of the use of hydraulic power, and in requisitioning Messrs. Ellington & Woodall, of West-

minster, as designers of the power station, the commissioners have benefited from the services of a firm specially experienced in this class of work. The site of the power station is at the corner of High Street and Rotten Row, a triangular piece of ground formerly occupied by old and most undesirable dwelling houses. The station buildings, it is believed, will be sufficient to meet all likely needs for some years to come. They are erected on sloping ground, and are of a castellated character, picturesque in themselves, and harmonizing well with the surrounding structures. A prominent feature is the octagonal chimney stalk rising from a red sandstone square base to a height of 160 ft., terminating in a battlemented crown. The height of this stalk has been arranged with the object of avoiding annoyance from smoke, and with the same object in view special appliances have been fitted to the furnaces. The boiler house is 84 ft. 6 in. long and 64 ft. wide, while the engine house is 76 ft. long by 40 ft. wide. On top of the buildings is one of the most notable portions of the plant, a huge iron tank with a capacity for no less than 200,000 gallons of water. In the construction of this reservoir plates ranging in thickness from $\frac{3}{4}$ in. to $\frac{5}{8}$ in. are used, having been subjected, prior to their being fitted, to most severe deflection tests. The whole tank, which is 9 ft. deep by about 86 ft. square, is subdivided into two portions by a strong partition near the middle. The plant at present installed is only equal to half the capacity of the works. It consists of four large Lancashire boilers with economizers, three sets of pumping engines of 200 horse power each, and two accumulators. In a future issue we hope to give illustrations and fuller details of the plant and the system as a whole. In fixing the pressure at half a ton to the inch, the commissioners have followed the lead of Manchester, the desire being to cater for that class of customers who have a special need for power for packing presses. Each of the pumping engines will pump 280 gallons of water per minute against an accumulator pressure of 1120 lb. and this with a steam pressure of 120 lb. The accumulators, two in number, have rams 18 in. in diameter, with a 23 ft. stroke. The cylinders are cast in one length, and the rams are also each of one piece of cast metal turned. The engines work independently, each one delivering into one of the four 7 in. main pipes. While the pressure on these is supplied from the accumulators, they have been so arranged that, should necessity arise, the pressure on the delivery mains can be supplied from one accumulator. The four main pipes have been laid throughout the district of supply in such a way that they form two separate circuits—one circuit to the north of Argyle Street—the grand artery running east and west in Glasgow—and the other to the south. At certain points there are cross connecting pipes with valves which will enable the system to be worked as one or two separate circuits. There is a further provision against stoppage of the whole hydraulic supply through fault at any particular place. Connected with the 7 in. delivery mains there are in the chief streets 6 in. and 5 in. pipes. All of these are provided with valves, enabling any street to be cut off from the general circuit should this be necessary.

The company at the inaugural ceremony on the 30th of June last included Lord Provost Bell and a large representation of the magistrates and Town Council, Sir William Arrol, Mr. Ellington, of Ellington & Woodall, Westminster, Mr. Gale, City's Water Engineer, etc. The Lord Provost set the pumps in motion, and the machinery was afterward inspected with interest. An adjournment was then made to the street, where the Lord Provost unveiled a large bronze tablet, bearing the city's arms and an inscription, on the facade of the northern tower. Two exhibitions of the high pressure were then given by Firemaster Paterson, by means of the fire brigade hydrants and hose, one at the pumping station, and the other in North Frederick Street. The water, especially when both forces were applied, rose to a great height, indicating clearly that there would be adequate hydraulic supply both for driving engines and also for extinguishing fire. The first public customers to avail themselves of the hydraulic power supply were the managers of the Conservative Club, to the lift in whose superb new premises in Bothwell Street the system has been laid on. An item in the inaugural functions was the setting in motion of this lift, the makers of which are Messrs. Steven, Provanside Works.

At the luncheon in the Municipal Buildings, which followed the inaugural proceedings, Lord Provost Bell presiding, Sir William Arrol, in proposing "The Water Commissioners of the City of Glasgow, and Success to the New Hydraulic Works," said no more important work had been undertaken by the commissioners since they brought Loch Katrine water into Glasgow. Glasgow was a great commercial city, and it was only by trade and commerce that they might prosper and hold their own amid the keen and severe competition which existed in all parts of the world. It was the duty of the commissioners to do everything they possibly could for the purpose of enabling the commerce of the city to be conducted in the most economical way possible, and he was sure nothing would help better to do that than the introduction of the high pressure water. There was another result of the introduction of the hydraulic pressure which he thought would also recoup the commissioners for their outlay. That was the relief of the domestic supply in the center of the city. By bringing in the high-pressure water, the commissioners would be enabled to get the use of water in the center of the city which had hitherto been used for hydraulic purposes. In another way this new scheme would benefit proprietors in the center of the city by enabling them to get the use of old properties which it would not pay them to replace, and where there was a lack of facilities for getting to the top flats. There would be very little difficulty in two or three neighboring proprietors putting in a hydraulic lift, and building an outside gangway leading to the separate properties.

The Lord Provost said it was very gratifying to the Water Committee and the Commissioners to hear such a favorable opinion expressed by Sir William Arrol regarding the hydraulic works. It was a special advantage that with the same number of hoists only a twentieth of the water would be required. That was most important, for it was well known that the demand quickly overtook the supply. Forty years ago Glasgow got a bill to supply the inhabitants with water, and in 1859 Loch Katrine water was introduced. In 1864 the domestic water rate was 1s. 4d. per pound; it has fallen till now it was only 6d., and the charge made for trade purposes was now only 4d., against 1s. Besides the committee and the commissioners had been able to pay off about three-quarters of a million of sinking fund, and had reduced the rate to an equal amount. They had supplied all charitable and benevolent institutions with a free supply. The same privilege had been given to the Health and Street Committees, and to all the institutions of the Corporation. These were no mean achievements. He hoped the works opened that day would be equally successful. The Corporation supplied to 900,000 persons, and would be able to do so to an increasing population. Sir William Arrol had well said that it was the best supply enjoyed by any large city in the world. Fifty million gallons were supposed to meet all requirements, but in four years the Corporation would be able to supply ninety million gallons per day. By taking water from Loch Goil there would be a watershed equal to that at present. There were no physical difficulties to interfere with the supply.—The Engineer.

THE DEVELOPMENT OF A NAVAL MILITIA.

By Commander JACOB W. MILLER, I Naval Battalion, New York.

THE ex-naval officer approaches the subject of the development of a naval militia with much diffidence. His early training and association naturally lead him toward the naval view of the question, while contact with the merchant marine, and practical experience in the details of organizing volunteers, tend to destroy some of his preconceived ideas concerning the scope of a State force. The interest which has arisen throughout the country in a naval militia is of such recent date, and the laws and conditions governing the corps in various localities are so different, that it may be scarcely time as yet to lay down any positive rules concerning the future of the movement. I can, therefore, only present the subject as viewed from the New York standpoint, prefacing my remarks with a general statement of the underlying principles which should govern the relationship between the civilian sailors and the United States navy.

The type of mind developed by military education is naturally prone to think that action by the central government should always precede local action. This trend of thought is increased in naval circles from intercourse with foreign countries and personal knowledge of monarchial methods. One of the strongest factors of our institutions, however, is the spirit of local autonomy, with its competitive and individual rivalries, working both for good and evil; and no project can become a national force until it has fought its way to success through the stress of primary discussion in the hamlet, the city, and the State.

This evolution is nowhere more apparent than in the rise of the militia of the United States. Immediately after the revolutionary war a national guard was proposed, under direct government control. The name alone remains to-day; all the steps which have been made during the past one hundred years having been on State lines, until, from the various inefficient "trained bands" of the past have grown the well equipped and disciplined bodies which are fast approaching an army standard.

The growth of a national naval militia, or, as it is generally called, a "naval reserve," would naturally be slower. Physical conditions separate the seafaring man from the landsman, and delay essential co-operation, while the occupation of coasters and fishermen makes them a race apart from their fellows on shore. Geographical and political reasons have also retarded the spread of the movement, individual and corporate effort having been turned, during the past thirty years, away from the sea toward the development of the interior. Many other reasons go to show how difficult it has been to focus the small seafaring population into any body for national defense; and it was, therefore, natural that all attempts from Washington and Jackson to Whithorne should have resulted in failure. Such a body will ultimately be formed, but not until a revived merchant marine shall have grown into larger proportions; commercial ships and crews will then be united with the government non-combatant marine forces by some wise legislation which the navy and the general government shall evolve. Even so great a nation as England, with its extensive fleet and seafaring population, has not as yet perfected an efficient "reserve," and it is scarcely to be expected that the United States can for a long time solve the problem.

The question then arises: Can we enlist the interest of the States in a movement looking to the protection of their own immediate coasts? This question was no sooner asked, some six years ago, than it was answereed by the enlistment of some three thousand men in the various battalions which now form the naval militia of nine States. The success of the movement was due to its local characteristics as outlined above, as well as to the fact that the building of our new fleets had kindled a sentiment which is already spreading beyond commonwealth lines toward broader national patriotism. Experience has more and more forced upon the mind of us, who had the honor of being in the navy, that our earliest conception of forming at once a school of education for the "forecastle" was erroneous and a waste of effort tending to jeopardize the movement.

The results, even of the first cruises, in 1891, were more direct and tangible from a State than from a navy standpoint, for, while a close and most friendly relation was developed between the officers and men brought in contact, the regular service as a whole was naturally skeptical of the future usefulness of raw recruits, whose main claim to recognition was enthusiasm and a certain longshore knowledge. The direct and immediate need of the navy at that time was an increase of foremast hands, and the composition of the battalions was not thought to be capable of supplying deep-sea sailors—a criticism which in its direct application was perhaps just, and subsequent years seem to have only enforced this naval opinion. Indirectly, however, the naval militia was building up a sentiment which was of far more value than an increased complement, and its influence was the more felt because the personnel was of a type taken from the higher walks of life; experience in the State land forces having proved that the example of a high grade of privates, in crack regiments, permeates at once to those composed of the lower orders. Furthermore, the original battalions are an officers' school for future ones, which will eventually be formed from the longshoreman and sailor class, a type pre-eminently fitted for emergency men-of-wars men. The natural and laudable ambition of the regular officer to reach the ultimate rank in a profession which in time of peace gives slight hope of promotion, should never be checked by the chance of outsiders coming between him and high position in time of war. The duty of the militia officer, therefore, should be limited to his State, and his pleasure unlimited in advancing unselfishly the interest of the naval service.

The immediate outcome from the State point of view was more direct. The favorable comment which the first cruises obtained begot in the commands a resolution to supplement enthusiasm by discipline, while the example set by the crews of the white squadron developed a capacity for work which has rarely been surpassed by volunteers. The spirit was reflected throughout the State, producing a result at Albany in a liberal appropriation. In order to continue this good will the naval militia had to show a definite aim, based upon State defense, and that aim had also to bring it into close touch with the national guardsmen without interfering with their finances or recruiting. The early difficulty was to learn exactly how and where this dividing line should be drawn while keeping up a relationship with the navy. The feature which largely determined the problem was the geographical characteristics of the State, with its extended water front on the lakes and the ocean.

It had been remarked that the naval militia could never occupy the same position toward the navy that the land militia does toward the army; the two latter could combine more readily, as the differences between them are only in degree of discipline, both acting on the land; whereas the naval militia, in addition to discipline, was compelled to master the intricacies of a sea duty, foreign to its civilian and shore habits. It was manifestly impossible to accomplish this in a five years' enlistment, in addition to the requirements of general headquarters, as the actual experience of life on board ship was necessarily limited to a week's annual cruise. In default, therefore, of attempting to create a man-of-wars man from the citizen sailor, what was the best practical result to be attained? Evidently, with our environment and limitations, to perfect a thorough knowledge of the coast and waters of our commonwealth, and to act as an amphibious connecting link between the navy, as a first-class line of defense at sea, and the army and national guard on shore. A glance at the State of New York will show how essential it is to have a force of this nature, and a little reflection will convince the most doubtful that there is sufficient work to be done to occupy a volunteer body for years to come. It has been the definite aim of the naval militia of the State to follow this policy during the last four years. Three annual cruises of short duration have been made with the navy, their object being to perfect gunnery practice, to obtain a general idea of modern naval methods and of the rudiments of ship life; but these tours afloat have always been within State waters. One independent cruise was made as a preliminary study of a portion of Long Island Sound, in order to crystallize the command into a self reliant body. Expeditions of several hundred miles were taken last summer, to familiarize the men with littoral navigation and to create in them handiness in the management of small boats. The results of the expeditions have been tabulated, and the Naval War College, at Newport, has been furnished with information concerning the eastern end of the Sound which had never been before prepared for war purposes, by men who had made study of definite and specific localities.

Great stress has been laid upon signal work, as practiced both by the national guard and the navy, as well as upon all other duties essential to prompt communication between land and sea forces. Permanent signal stations have been established upon the coast after a personal examination of their necessary characteristics, lists of available craft for transportation and torpedo boats have been prepared, and while all these activities were being pursued during the summer, against the time when some foreign war might arise, the winter months have been utilized in perfecting a system which might meet this remote emergency, and also make the naval militia effective in the much more immediate and pressing problem of domestic disorder arising near the water front.

The organization of a State marine force must be modeled on naval precedent: hence the terms and titles employed have been those of the service. The "divisions" when united are analogous to the crew of a modern ship; when subdivided, each smaller portion, as well as the individual, readily falls into place on board a man-of-war. The "quadrantal" or "quadri-sectional" system was adopted, even before the navy officially recognized its superior merits. Space will not permit a description of that system, but, through it, the transition from sea duty to coast work, and thence to co-operation with the land forces, has been rendered simple, the battalion organization giving equally good results, whether it be temporarily on board a cruiser manipulating great guns or near shore protecting a dock as light artillery; and each division, whether manning tugs or acting simply along the water front, has within it all the requisites essential for such detached duty. No expert class, except such a one as can be developed within the division, is allowed, it being the intention that the unit shall ultimately contain the required percentage of signalmen, torpedoists, engineers, messmen and local pilots necessary for independent action.

Such in brief has been the aim and effort of the New York Naval Battalion during the past five years. It has not attained perfection even in State work; but it has labored conscientiously and with due regard to the helpful appreciation received from the people and the government.

Having established intimate and cordial relations with the navy on one hand and the national guard on the other, the next step of making some practical

combination between the different militant forces follows as a natural sequence. A beginning was made in this direction last year, when the navy, the artillery and the militia of two States communicated by signal from Block Island to Fort Trumbull. A further amplification in the way of joint maneuvers could be easily accomplished. It so happens that a large fleet will be in this vicinity during the coming summer, and that it will be commanded by an admiral anxious to co-operate with the other branches of the service. The president of the War College at Newport is, moreover, now engaged upon the problem of the defense of the coast. The Adjutant General of New York has also lately issued an order that certain regiments may perform duty in the field in lieu of the ordinary camp routine at Peekskill, while the numerous army posts between New York and Boston are in a position to assist. A little energy on the part of the various officials could bring these commands together at that most vulnerable point, the eastern end of the Sound. The proposed plan does not involve the mobilization of large numbers; a detail of two regiments of national guardsmen, the naval militia and a few regulars would be sufficient, the numerical force, both land and sea, being based upon a general percentage of one hundred to one. Keeping this latter point in view, the fleet could be divided into two squadrons, one representing the attack and the other the defense. Five hundred national guardsmen by taking a transport in the afternoon would reach Montauk early on the following morning, acting there as the enemy's troops and landing under cover of the guns of the fleet; another regiment to go by rail down Long Island, the naval militia becoming its flankers on the sound and on the bays of the south shore. At Gardiner's Bay they would unite with the squadron of defense, the home forces and the enemy meeting on the main line near Sag Harbor, where a series of tactical and strategical movements could take place. The addition of a small cadre of Connecticut and Rhode Island militia would materially assist in signal work across the race, and in manning light artillery and placing mines near Greenport. Five days of such a campaign would cost no more than a week at the State camp, and would be as interesting as it would be instructive, serving also as an object lesson for civilians who know too little of what is being done by the military and naval contingents. The most important result, however, would accrue to the various forces participating, each learning from the other the defects which undoubtedly exist to-day to prevent successful results in case of a war emergency.

It may be well to note these defects, or rather differences, between the various arms of the service. The army has recently adopted a small arm of different size bore from the navy; the militia has other guns and their calibers are not identical. If, therefore, ships and troops were massed to-morrow at the intersection of the three States, near the mouth of the Thames River, and an action occurred, it might be lost for want of a common ammunition. The forces would also be without a pre-arranged signal system. The army and the national guard use the "Morse" and the navy the "Myers" Code, while the naval militia, in its province as a connecting link, endeavors to learn both, but only with doubtful success. The "wig-wag" should be as familiar as the mother tongue, and no two sign languages can be equally mastered.

The navy also has a distinctive set of sea signals known as the "Navy Code." This code is printed in a large volume which consists of two distinct parts, embracing the system and the vocabulary. Flags and lights of various sizes, shapes and colors are hoisted to denote certain meanings. The principles given in this code are not in any sense an index to the vocabulary, nor does the drill concerning the arrangement of the symbols serve as a guide for their interpretation; and yet the Navy Department, with a conservatism which may lead to dire results, looks with extreme disfavor upon any State organization having access to its "Signal Book;" the reason being given that the messages printed therein would become common property. The self-evident and immediate answer to this objection is that an expert hostile signalman could master the vocabulary within a few hours, and that no admiral would be worthy to command a fleet in time of war unless he used a cipher and changed that cipher daily. The navy signal book should at once be printed in two parts, the first part containing the principles involved as well as all other data, except the actual numbers denoting certain messages. These latter should be in a separate volume, while the first part should be placed in the hands of all the naval militias, so that any off-shore action may not be jeopardized for lack of prompt transmission of orders between land and sea. Prearranged combinations and permutations are easily and quickly arranged, but practice alone will create exact manipulation of the symbols used.

One other cause which exists and prevents effective coalition is the lack of modern instruction books dealing with longshore work. The recently adopted small arms have necessitated many changes in the tactics, and the army and the navy have drifted apart, the navy using certain land methods in their drills, while discarding others, until to-day the "Instructions for Infantry and Artillery" are so full of errata that a new edition should be printed. The same neglect of keeping other text books up to date is noticeable, and it is impossible for the militia to drill properly until the bureaus at Washington can promptly supply late and standard publications; even the antiquated "Ordnance Instructions" cannot be had, and no late edition of the torpedo drill book is accessible. The "Navy Regulations," although revised some two years ago, cannot be obtained in sufficient quantities to meet even the requirements of the service. No pamphlets are issued showing the new uniform, adopted by the board of officers appointed for that purpose; no station bills are published for the latest type of cruiser, while it has been reserved for an officer of Massachusetts to make the first compilation of departmental circulars relating to great gun exercises. Numerous public documents are scattered by Congress broadcast over the land, only to be thrown into the waste paper basket, while students of naval subjects have their applications for books returned from Washington with the indorsement that "none are on hand" in the navy.

These patent defects are referred to not in any spirit of hypercriticism; equally grave ones perhaps exist in the army, and should be treated by some one more closely allied to it than the writer; they are mentioned only to be remedied, and certainly should not discourage the effort for a closer alliance between the State and government forces. On the contrary, the different branches of the service should be brought practically together, in some small way, at the earliest opportunity, and thus learn through existing discrepancies the lessons of future success. Until this next and most important step is taken, there is little use in attempting to form a national reserve. It takes years of buffeting on the seas to create the Anglo Saxon sailor, and it would be effrontery for the naval militiaman to suppose that a few short cruises could fit him for the position of an American man-of-wars man. The few navy men who think that such is the aim of the volunteers belittle the men who serve in the forecastle and are unappreciative of the possibilities of their profession. The larger number of officers have understood the true scope of the naval militia as well as the dignity of their own calling, and have thus materially assisted the small but zealous corps in its efforts to learn its duties in shallow waters before venturing upon the intricacies of deep-sea navigation.

At the close of the first four years of its existence, the naval militia shows an increasing membership and vitality. It has decided what are its immediate duties; and is studying its future ones. Its next steps should lead it toward some combination with the departments controlling the municipal tugs, so that these small vessels and their crews could co-operate for a few days during the year with the militia. There should be allowed to each naval battalion an engineer with a few petty officers under him, and these men, together with the engineers of the tugs, would form a nucleus which could be easily exercised in naval duties and increased by the addition of firemen and coal heavers when necessity demanded.

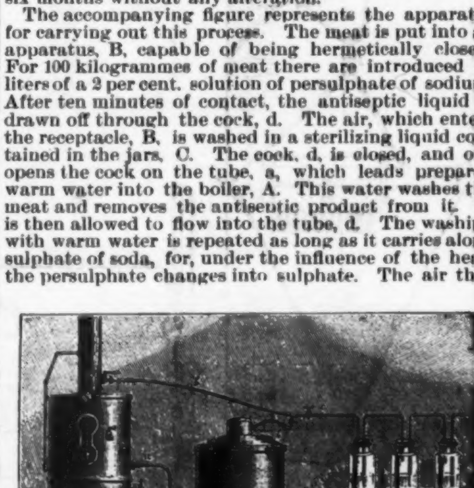
After the organization has proved its staying power, inducements should be held out to the Corinthian yachtsmen to join a navigating or torpedo corps. Small steamers flying the naval reserve flag of the State would thus be added to the naval brigade and would be of much service in creating a force whose duty it would be to assist in collecting coast information and giving facilities for torpedo exercise.

With these aims realized, the time shall have arisen for creating a national reserve embracing merchant vessels and their crews, as well as the collateral marine interests; but this plan can never be practically successful until the whole country has awakened from its present dormant condition concerning all maritime affairs.—Journal U. S. Artillery.

THE PRESERVATION OF MEAT.

DR. WAEKER, of Monaco, has recently proposed quite an original process of preserving meat, which consists in washing it with an antiseptic liquid soluble in water and decomposable by heat into a product that also is soluble in water. This liquid having destroyed the germs of fermentation, the meat is washed with boiling water in order to remove the antiseptic from it. As all the manipulations are performed in air freed from bacteria, the meat may be preserved for six months without any alteration.

The accompanying figure represents the apparatus for carrying out this process. The meat is put into an apparatus, B, capable of being hermetically closed. For 100 kilogrammes of meat there are introduced 20 liters of a 2 per cent. solution of persulphate of sodium. After ten minutes of contact, the antiseptic liquid is drawn off through the cock, d. The air, which enters the receptacle, B, is washed in a sterilizing liquid contained in the jars, C. The cock, d, is closed, and one opens the cock on the tube, a, which leads prepared warm water into the boiler, A. This water washes the meat and removes the antiseptic product from it. It is then allowed to flow into the tube, d. The washing with warm water is repeated as long as it carries along sulphate of soda, for, under the influence of the heat, the persulphate changes into sulphate. The air that



APPARATUS FOR PRESERVING MEAT.

enters the boiler, A, during the manipulations becomes likewise purified in C.

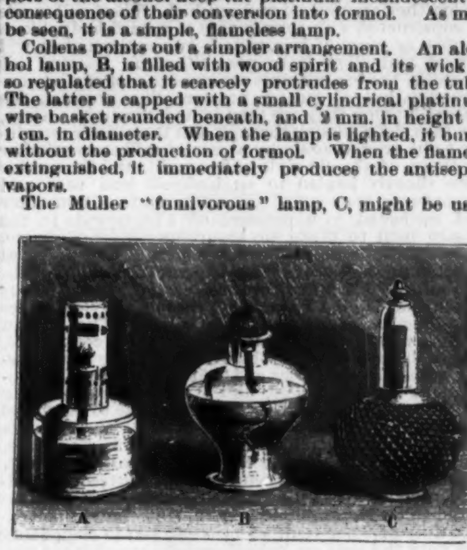
Into the jars, C, is put sulphuric acid or any other liquid that destroys germs and is incapable of being carried along by the air.—La Nature.

ANTISEPTIC LAMPS.

FORMIC aldehyde, or formol, is, as well known, a powerful antiseptic. The commercial product is obtained by oxidizing methylic alcohol or wood spirit. The idea has been conceived of constructing lamps to burn wood spirit so as to disengage vapors of formol capable of disinfecting apartments, hospitals, barracks, schools, workshops, etc. The process is simple, very easy and quite cheap. We present herewith three styles of the lamps. Style A is the Trillat formogen lamp. It consists of an alcohol lamp surmounted by a cylinder, b, that presents, from top to bottom, two series of regulatable orifices. A piece of platinum wire gauze extends through the cylinder. The lamp is filled with methylic alcohol, lighted, and capped with its cylinder. After the gauze has become incandescent, the flame of the lamp is extinguished. The vapors of the alcohol keep the platinum incandescent in consequence of their conversion into formol. As may be seen, it is a simple, flameless lamp.

Collens points out a simpler arrangement. An alcohol lamp, B, is filled with wood spirit and its wick is so regulated that it scarcely protrudes from the tube. The latter is capped with a small cylindrical platinum wire basket rounded beneath, and 2 mm. in height by 1 cm. in diameter. When the lamp is lighted, it burns without the production of formol. When the flame is extinguished, it immediately produces the antiseptic vapors.

The Muller "fumivorous" lamp, C, might be used



ANTISEPTIC LAMPS.

for the same purpose on filling it with wood spirit in place of common alcohol.

From the experiments made, it appears that it is necessary to burn two liters of methylic alcohol in order to sterilize a room of 100 cubic meters. The vapors of formol do not alter pieces of furniture.—La Nature.

PEANUT OIL.

THE seeds of the ground nut yield a clear, straw-colored, non-drying oil, resembling olive oil in appearance and taste, and, in fact, when properly prepared, as in France, it is difficult to distinguish the two products. The chief points of distinction between them are that the peanut oil is lighter and more limpid than that expressed from the olive, and also cheaper; the two features explaining the fact that the bulk of the olive oil imported from Europe is very largely adulterated with its rival.

Its uses are quite extensive all over the world. In India it is a common substitute for olive oil in medicinal preparations. It is also utilized as a lamp oil, having the advantage over other oils that it lasts longer before becoming rancid. It does not contain, however, as much illuminating power as some other vegetable oils. It is also an important ingredient in the manufacture of soaps, especially the fine white soaps for which France is noted.

The finer parts of the first pressing are also used in the manufacture of oleomargarine and other compounds used as substitutes for butter. Peanut oil is also preferred for lubricating locomotives, sewing machines and other fine machinery, owing to its tenuity and the freedom with which it flows.

The yield of oil varies greatly. In Bombay, for instance, it averages fifty per cent. of the weight of milled seeds; in Pondicherry, thirty-eight, and in Madras forty-three. It is claimed that when the oil is pressed out without any heat its quality is improved, while the heat process increases the quantity. Until recent years the bulk of the oil imported into Europe was manufactured in India by the natives there, but since the opening of the Suez Canal the low freights have transferred the manufacture of oil to European countries, where finer machinery and more careful manipulation have greatly improved the product, while reducing the price.

Twenty-five years ago there were at least four of these oil mills running in the Southern States, the product of which was largely used in lubricating spindles in the cotton factories and as a substitute for lard in cooking and in bread and pastry making, and the foods thus prepared are said to be thus greatly improved in flavor.

The manufacture of peanut oil has, by some unaccountable reason, centered in Marseilles, in the South of France, and in some parts of Germany, where, during the last ten years, it has developed into a great industry. Most of the nuts used up in these districts are imported from the east and west coasts of Africa, Mozambique, India, the United States and, on a limited scale, from the Argentine Republic.

The best grades for the production of oil, however, come from the valley of the Senegal, in Africa, yielding fifty-one per cent. of oil in weight. The American peanut is smaller in size, but much finer in grain and of better flavor. The oil, however, is of inferior quality, and the nuts yield only about forty-two per cent. of oil. Hence the manufacture in the South has fallen into decay, and can never revive unless by the same enterprise which has been exhibited in Marseilles and Germany, namely, by importing the nuts in bulk and on a large scale.

In Marseilles and the vicinity seventeen factories are devoted to the peanut oil industry, though not exclusively to that product. All of these manufacture at different times, by the same machinery and practically the same processes, the various vegetable oils. Extraction of oil from peanuts is, however, rapidly increasing, the quantity of nuts imported at Marseilles for this purpose during 1893 exceeding by sixty-nine million pounds the importation of 1862. The processes of producing the oil are substantially the same, the details consisting in the use of parts of the machinery (which are covered by patents) without modifying the general system. Most of the nuts are imported shelled, owing to the greater loss with which they are shipped. On arriving at the factory they are placed in a winnowing machine, not unlike an American wheat fan,

in which, by means of a current of air, all dust and dirt are removed. They are then thrown into a cylinder through which they are propelled by an archimedean screw to a pair of heavy iron rollers, through which they are pressed and crushed. These rollers are so constructed with springs that if a hard body, like a pebble or piece of iron, gets between them, they will spread and allow it to pass through. Leaving this machine, the bruised nuts enter another of similar construction, but of greater pressure, thus crushing the nuts still more; they are then bolted through a sieve, the finer flour passing through and the coarser remaining to be ground again by a pair of mill stones similar to those of the old style of flour mill, and the meal is then slightly heated in an inclosed iron case and pressed into bags called scourbins, made of horse hair and subjected to a pressure of 2,850 pounds to the square inch to make the scourbins compact. At the end of an hour, all the oil being pressed out, the meal is again ground, heated to a temperature of 158° Fah. and subjected to a final pressure, which yields about 13 per cent. of oil. In the two pressings the yield varies according to the quality of the peanuts. The African or Mozambique product gives about 50 per cent. of oil, or half the weight of the shelled nuts, at the first pressing, valued in Marseilles at $13.51 to $18.34 per 100 kilogrammes (220·46 pounds), and at the second pressing 12 to 18 per cent., valued at $8.69 to $9.65 per 220·46 pounds. As we have said, the bulk of the peanuts shipped from Mosambique finds its way to Marseilles, that city absorbing 65 per cent. of the entire product. Of the balance, 25 per cent. goes to Rotterdam, Holland, and the rest to Hamburg and other German ports. The Mozambique government charges an export duty of 2 per cent. ad valorem, and in computing this duty the nuts are valued uniformly at $30 per ton. —Confectioners' Journal.

THE SHARPENING OF FILES BY SAND BLAST.

MR. DESGEANS, engineer of the shops of the Company of the East, at Epernay, and Mr. Fort, an inspector assistant to him, have recently published in the Revue Generale des Chemins de Fer an important paper upon the sharpening of files by sand blast.

As judiciously remarked by the authors, the fact must not be lost sight of that, in the net cost of working by file, manual labor is the most important factor. In order to determine the limiting point starting from which it is no longer advantageous to employ files, in taking into account their own value and the time passed in using them, the authors have made prolonged experiments with three types of these tools—rough, bastard and smooth.

Graphics established with care show what the production of one kilogramme of filings costs in files and hand labor as a function of the total duration of the use of the file considered. The gross expense passes through a minimum that is the limiting point sought, to which corresponds the most economical rendering of the type of file considered.

This point presents itself respectively for the three types above mentioned after ten and a quarter and nine and a quarter hours' use of each of their faces. It is at this moment that either resharpening or a definitive reformation becomes necessary.

It is unnecessary to say that any renewal that did not have the effect of causing the teeth to maintain their capacity of production and consequently of in-

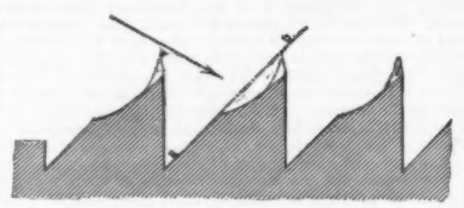


FIG. 1.—ENLARGED PROFILE OF THE TEETH OF A FILE.

creasing their duration of service would not constitute a real economy.

Messrs. Desgeans and Fort, in the first place, endeavored to ascertain whether the chemical processes that have been in use for a long time in large workshops for prolonging the life of files are sufficiently efficient and effect an appreciable saving.

The well known process of immersing files in acidulated baths has given but quite mediocre results. It does not permit the tools to recover their former keenness; and sometimes, even, the edges of the teeth seem to have become corroded rather than sharpened.

Sensibly analogous results were obtained with files treated by what is called the process of recutting by electricity, in which the chemical action of acids is combined with a disengagement of hydrogen, which, in a manner, isolates the edges in the bath and protects them against the inconvenience noted above.

Files that have undergone either of such treatments are sensibly less active than in a new state, and a continuation of the use of them is more onerous than their restoration.

The same is not the case with sharpening by the sand blast, by the Tilghman process, already known to our readers.

The use of this "liquid grindstone," as its inventor calls it, gives very good results. It not only permits of renewing the teeth of files that have already furnished a normal amount of work and of giving them a sharpness equal to that which they possessed when new, but also of sensibly increasing the sharpness of new files themselves by causing the disappearance, through a preliminary dressing of the burrs formed at the edges through the curling of the metal at the time of shaping.

Fig. 1 represents on a large scale a profile of the teeth of a new saw before sharpening (dotted lines) and after this operation (unbroken lines). Under this latter form the files evidently bite better, and, all things remaining equal, their production ought to be greater.

The first trial, made in 1883 at the Epernay shops, permitted of verifying the useful effect of such sharpening, but, at this epoch, the license fees required by the granters of the patents were such that the net cost did not sensibly differ from the cost of the pure and simple resharpening of the files.

Since then, the Tilghman apparatus has become distributed through the industries, and several railway companies, especially those of the North and Orleans, have furnished their shops with it. The good results obtained in these latter and the notable reduction in the license fees made by the Tilghman Company decided the Company of the East, in 1891, to install one of the apparatus in its shops at Epernay.

Before speaking of the results obtained, it is well to briefly recall the operation of the Tilghman-Mathewson apparatus, such as it is now used.

The different parts composing the sharpening apparatus are grouped around an iron plate cylinder, A (Figs. 2 to 4), in which the projection of the sand is effected. This cylinder is prolonged at the upper part by an exhaust chimney. The steam, furnished by a near-by generator, is led through the pipe, E F, and the branches, DD', to the two ejectors, CC'. A separator of the entrained or condensed water is interposed at G.

From the main pipe, E F, there branches a tube, I K, designed to lead into the cylinder, L, the steam necessary to force into the reservoir, N, in measure as may be needed, the mixture of water and sand contained in the tank, M. The latter and the cylinder, L, communicate below through the orifice, O, upon which rests a weighted rubber ball, P, forming a valve. A valve, s, limits the pressure of the steam in the cylinder, L, to 750 grammes per square centimeter.

At the atmospheric pressure, the mixture contained in the tank enters the cylinder, L, where the level is established, as shown in Fig. 2. If, at this moment,

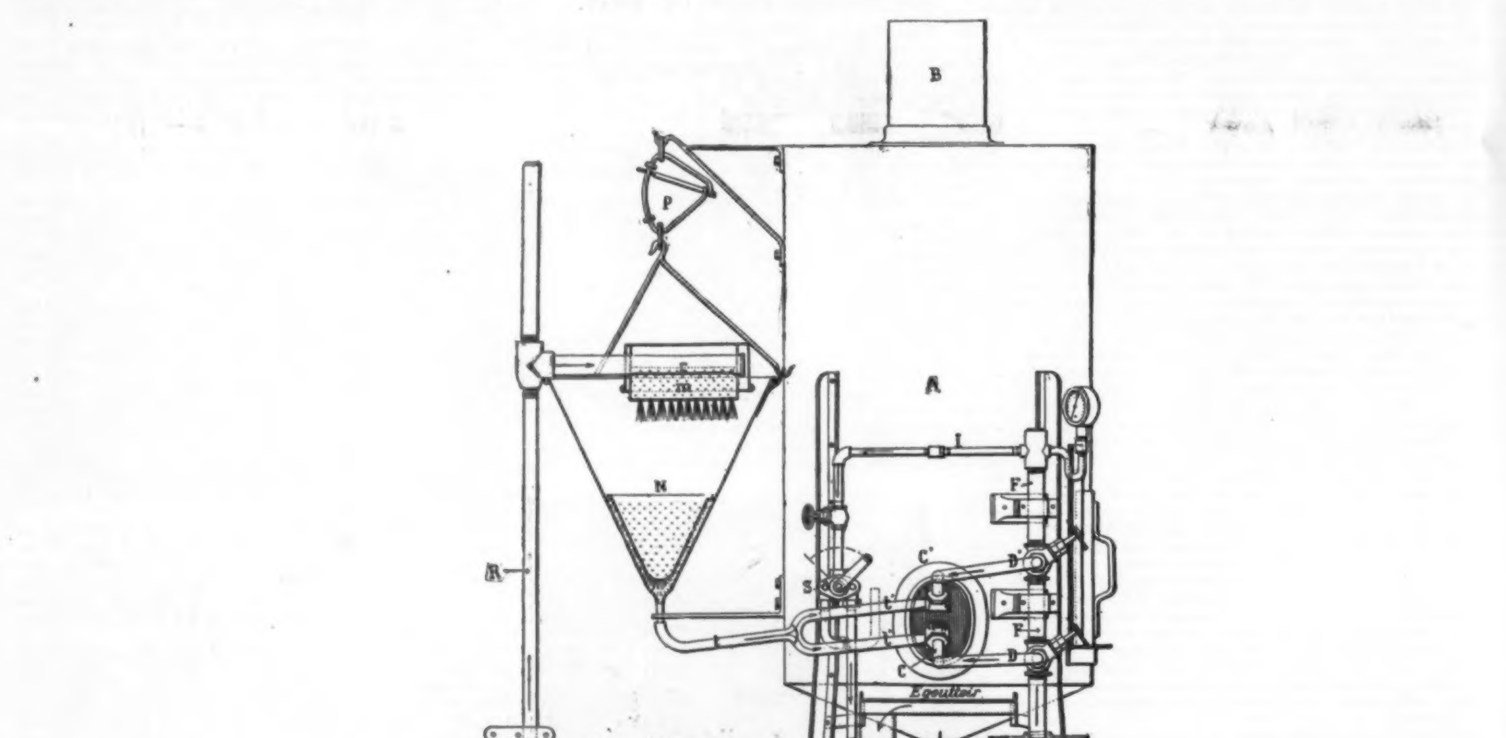


FIG. 2.—ELEVATION AND VERTICAL SECTION OF THE SAND BLAST APPARATUS.

steam be introduced into L, the valve, P, will close the lower orifice, the liquid will become heated to the boiling point and rise in the pipe, Rr, and fall, in traversing a sieve, m, into the reservoir, N. Thence the liquid is led to the ejectors (Figs. 6 to 9) through the pipe, t, and its prolongations, t t'. A three-way cock, S, maneuvered periodically, opens or closes the admission of steam through the pipe, K, in such a way as to alternate the filling of the cylinder, L, with that of the reservoir, N. The spring balance, p, guides the workman in the maneuver of this cock.

which the drops of condensed water escape in order to fall back into the receptacle, G.

Figs. 10 and 11 represent an ejector in the position of working upon a file, l. The steam, introduced through the pipe, d, escapes through the rectangular orifices, a, and carries along the mixture of water and sand, which flows from the pipe, t' (Fig. 2), through the central piece, c, and the conduit, b. The grooves of the first cut of the file are parallel with the sides of the extremity of the ejector, and the blast strikes the back of the teeth at an angle of about 70 degrees, as

ferent degree of wear of the two opposite faces necessitated a different treatment as to duration. In practice, such distinction is not appreciable, and it is possible, without inconvenience, to employ two superposed ejectors that act simultaneously upon the two faces of the file.

With equal hand labor, this combination of two blasts increases the production of the apparatus by from 30 to 35 per cent.

In current work, in order to ascertain what results they are obtaining, file sharpeners, from time to time,

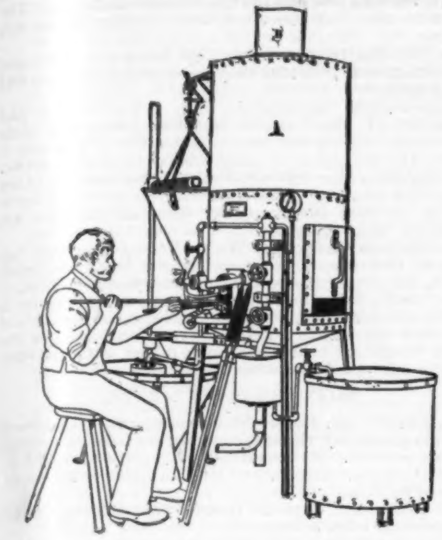


FIG. 3.—PERSPECTIVE VIEW.

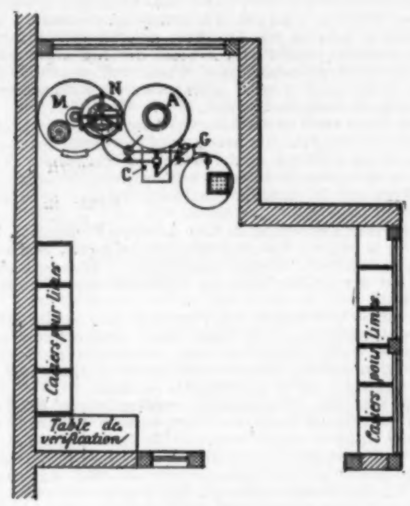


FIG. 4.—PLAN OF INSTALLATION.

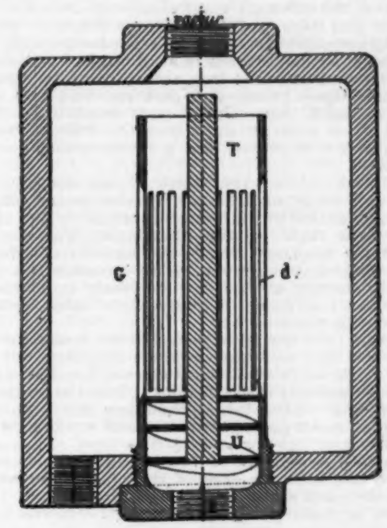


FIG. 5.—SEPARATOR OF WATER OF CONDENSATION.

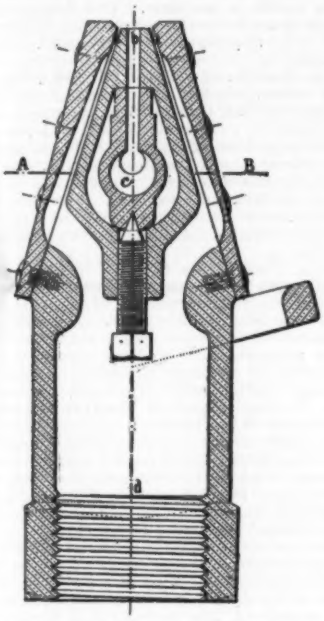


FIG. 6.—TRANSVERSE SECTION.

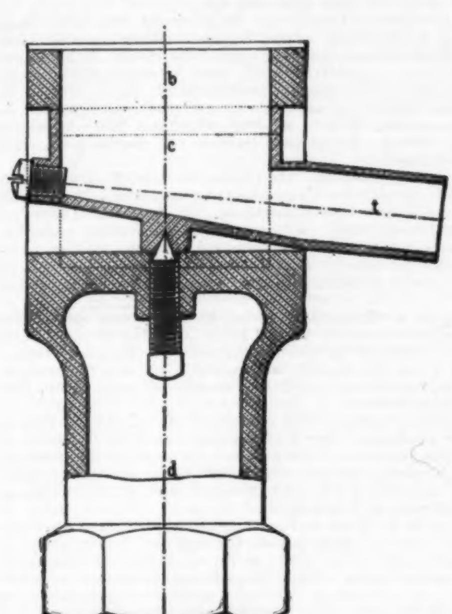


FIG. 7.—LONGITUDINAL SECTION.

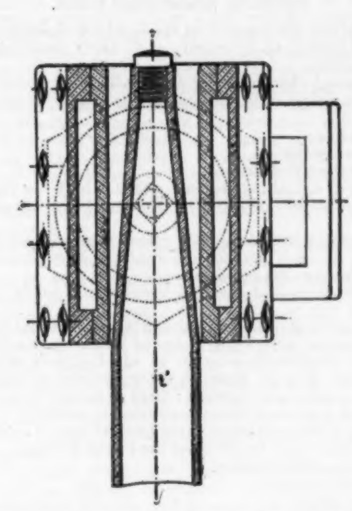


FIG. 8.—SECTION THROUGH A B.

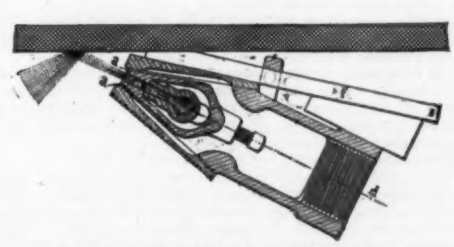


FIG. 10.—MOUNTING OF THE FILE UPON THE PROJECTOR.

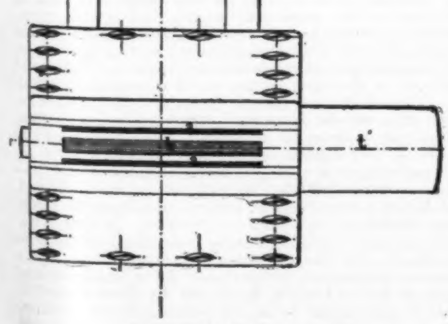


FIG. 9.—PLAN VIEW.

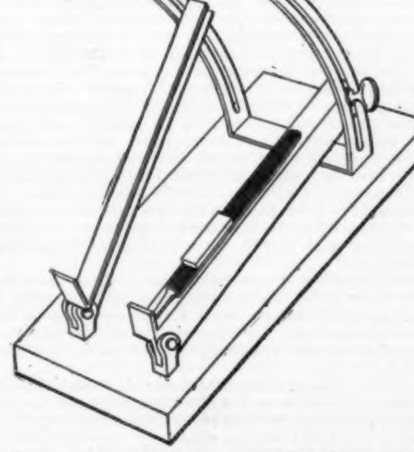


FIG. 12.—APPARATUS OF VERIFICATION.

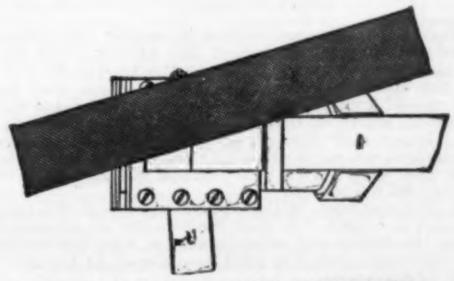


FIG. 11.—PLAN OF THE MOUNTING.

The drier, or separator of water of condensation, G, represented in section in Fig. 5, is based, like most similar apparatus, upon the action of centrifugal force for isolating, by reason of their difference in density, the aqueous globules in suspension. At its exit from the pipe, E, the steam traverses a spiral, U, which gives it a helicoidal motion. This spiral is inclosed in a vertical tube, T, provided with apertures, d, through

shown by the arrow in Fig. 1. A brass holder, f, supports the file and indicates through the increasing adherence of the latter the progress of the sharpening. The sand projected against the file falls to the bottom of the vessel, N, and returns to the tank, M.

At first, the Tilghman apparatus was provided with but a single ejector. It was then thought that, for the resharpening of files that had been used, the dif-

before and after sharpening, take, by means of the apparatus shown in Fig. 12, the angle of inclination that corresponds to the limit of adhesion of a metallic prism freely placed upon the file to be tested. Such verification permits of estimating the increase in sharpness produced by the operation. The divergence of the two angles taken upon the same file is, on an average, 15 degrees. These angles themselves, which

vary with the width of the files, are generally comprised within the following limits: Before sharpening, from 20 to 30 degrees; after sharpening, from 35 to 45 degrees.

In order to determine the duration of the useful effect of a sharpening, the number of resharpenings that a file may effectively undergo in the course of its use, and the increase of production that results therefrom, Messrs. Desgeans and Fort made a methodical test of a few files of the most usual dimensions and of the three types, rough, bastard and smooth. Two files of each type were employed, upon one of their faces in the state in which they come from the manufacturer and upon the other after a preliminary dressing.

These files were used upon bronze solely, it not appearing necessary to repeat the experiments upon iron, because, as a general thing in all shops in which bronze and cast and wrought iron are worked, the files are first used upon bronze and cast iron and then solely upon wrought iron. Under such conditions, after a period of use upon wrought iron, the state of wear of such files is so advanced that a resharpening becomes useless.

The results of the experiments above mentioned led to the following conclusions: A resharpening effected after each period of trial of ten hours gives files of the rough type their pristine sharpness. For files employed for working bronze, the number of effective sharpenings may be seven. This number is a limit, since in current service it is evidently impossible to realize the conditions of regularity of work obtained in these experiments.

Starting from this third period of ten hours, the non-sharpened files no longer produce anything but negligible work, while the sharpened ones are still capable of furnishing forty hours of work. Like the preceding, bastard files with seven sharpenings are capable of furnishing seven periods of ten hours' work upon each of their faces. As for smooth files, they are capable, with two sharpenings, of furnishing two periods of seven hours' work for each of their faces, and by reason of the small size of their teeth there would be no interest in sharpening them further. — Revue Industrielle.

NOTES ON SOME SAPS AND SECRETIONS USED IN PHARMACY.*

By P. L. SIMMONDS, F.L.S.

THERE are very many of these which deserve special detailed notice, at all events as to their medicinal uses and statistics.

Four subdivisions might be established under which all the varieties of gums and resins might be grouped:

(1) Gums.
(2) Resins.
(3) Oleo-resins.
(4) Elastics and gums.

The first would include all gums wholly or partially soluble in water, whether of the acacia or tragacanth kind.

The second would include resins more or less soluble in alcohol, such as copals, mastics and gum resins, like asafetida and ammoniacum.

The third would include turpentine, wood oil and balsams.

The fourth would contain India rubber, balata and gutta percha, with substances of a similar character.

A resin is entirely soluble in alcohol, but insoluble in water. A gum resin is intermediate in character between a gum and a resin; that is to say, it is partly soluble in water and partly soluble in alcohol.

A kino is the astringent inspissated sap of a tree.

The resins may be divided into four groups:

(1) Solid or dry resins.
(2) Turpentines.
(3) Balsams.
(4) Soft resins.

Perhaps it is better to arrange the products alphabetically under their botanic names.

Abies balsamea, Marshall; Abies balsamifera, Michaux; Pinus balsamea, Lin.

Canada balsam is an oleo-resin produced from the stem of this tree by incision, and is also yielded by Pinus Fraseri, Pursh.

It is of a pale straw color, and is occasionally used medicinally, but is chiefly employed for mounting objects for the microscope, and as a fine transparent varnish for water color drawings, which does not become darker with time.

Abies excelsa, Poiret; Pinus picea, Du Roi.

Pinus Abies, Lin.—The resinous exudation of the Norway spruce fir, melted and strained, furnishes the concrete oleo-resin, true Burgundy pitch, the thus or frankincense of the London Pharmacopœia. The common frankincense or American thus is from Pinus palustris, Lambert; Pinus Tæda, Lindl. It acts as a counter-irritant, and is applied to the chest in chronic pulmonary complaints, to the loins in lumbago, and to other parts to relieve local pains of a rheumatic character.

The Indian gums are coming in largely into European commerce to supplement the African gums, the exports of gums for India having averaged 37,000 cwt. in the last five years. The African gums may be recognized from Indian gums by an expert, being of a different shade of color, often with a pinkish hue. The imports of gum arabic into the United States have declined more than one-half of late years; in 1892 they were only 417,000 pounds, but recovered in 1893 to 915,855 pounds.

Acacia Catechu, Willd.—The extract from this tree, known as "cutch," is used medicinally as an astringent, in fevers and other maladies, and the better qualities are equally as good medicinally as the gambier of Singapore.

There are several kinds of cutch made in India and used in medicine.

A resinous extract is prepared by boiling down chips of the wood.

In Burma and Bombay the decoction is boiled down to a solid consistence and thrown into leaf moulds, or is baked into cakes and balls. This is the ordinary cutch of commerce, and instead of being a pale grayish color, it is deep reddish brown, with a glassy fracture.

Another inferior kind is made from a decoction of the nut of the betel palm (Areca Catechu). This form exists in large slabs, about an inch in thickness, prepared on the leaves of the teak tree. This substance is, however, rarely exported from India, but a considerable local trade is carried on in it in Madras and Mysore.

Cutch is prepared thus:

The tree is cut down to about six or twelve inches from the ground and chopped into small pieces, the smaller branches and bark being rejected. The chopped wood is then taken to the place of manufacture, generally under trees in the open air, and placed over a brisk fire in clay jars, filled with about two-thirds of water.

This is allowed to boil down till, with the extracted matter, it forms a liquid of a sirupy consistence. The contents of several jars are then poured into a larger jar, and again placed over a brisk fire for a period of from two to four hours, and, when sufficiently boiled down, it is poured over mats covered with ashes of cowdung and allowed to dry.

Catechu is used in medicine as a gentle tonic and a powerful astringent, on account of the large quantity of tannic acid (50 per cent.) which it contains. Combined with opium it answers a good purpose as an internal remedy in chronic diarrhœa, catarrh or dysentery.

Cutch is not specified in the American imports, but gambier is named, but appears among gums, with the old misnomer of "Terra japonica." The quantity imported fluctuates between 27,000,000 and 35,000,000 pounds.

SUGARS.—The maple tree, several palms, the white beet root, sorghums, the sugar cane, and other plants and trees, yield saccharine saps, but as the product of these have chiefly dietetic uses, rather than medicinal, I shall not enter into details on them.

Aloes Species.—The simply inspissated juice of the leaves of various species of this gum constitutes the "aloes" drug of pharmacy. It is best obtained by using neither heat nor pressure for extracting the sap. By redissolving the aqueous part in cold water and reducing the liquid through boiling to dryness, the extract of aloes is prepared. All species are valuable in localities where they are hardy, and can be used (irrespective of their medicinal importance) to beautify any rocky or otherwise arid spot.

Aloe Ferox, Lamarck.—This yields the best Cape aloes, as observed by Dr. Pappe. Other species, such as A. perfoliata, Lin., also yield the drug. A. africana, Mill., and A. plicatis, Mill., and A. commelini, Salm., are said to yield a less powerful kind.

The following are also South African species: A. arborescens, Miller; A. linguæformis, Mill.; A. angulata, Willd. From this species the purest gum resin is obtained.

A. purpurascens, Haworth, is one of the plants which furnish the Cape aloes of commerce. A. spicata, Lin., also provides Cape aloes. A. Zeyheri, Harvey, a magnificent, very tall species, is doubtless valuable like the rest. A. soccotrina, Lamarck, is also indigenous to South Africa; A. dichotoma, Lin. fil., in Damara and Namaqualand, attains a height of 30 feet and expands occasionally with its branches so far as to give a circumference of 40 feet. The stem is remarkably smooth, with a girth sometimes of 12 feet. It is a yellow flowering species. A. Bainesii, Baker and Dyer, is almost as gigantic as the foregoing. Both, doubtless, yield the medicinal gum resin, like several others.

In many parts of the colony of Natal, a wild aloe is very abundant, and a few people make an industry of the preparation of the product for export. Shipments, of late years, have reached £400 in value. Small balls of it were shown in the Natal Court at the Colonial Exhibition in London.

A. indica, Royle.—There are many varieties of aloe met with in cultivation throughout India, some of which have gone wild, as, for example, on the coast of South India. The inspissated juice, as a medicine, is regarded as an aperient and deemed highly beneficial to persons predisposed to apoplexy. The fresh juice from the leaves is said to be carthartic, cooling and useful in fevers, spleen and liver disease, enlarged lymphatic glands, and as an external applicant in certain eye diseases. The pulp of the leaves is, in native practice in India, applied to boils and is regarded as acting powerfully on the uterus. It is largely employed in veterinary medicine. The root is supposed to be efficacious in colic. A. soccotrina, Lamarck; A. vera, Miller, is usually imported in skins and casks from Bombay. Soccotrina aloes may be recognized by its reddish tint and by the fragments being nearly transparent, as well as by its odor. A. Perryi, Baker, is indigenous to the island of Socotra. In very large doses it is a powerful hepatic stimulant. In small doses, the drug is used as a stomachic tonic. In larger doses purgative and, indirectly, emmenagogue. It is a remedy of great value in constipation caused by hysteria and atony of the intestinal muscular coat. It is also very useful in atonic dyspepsia, jaundice, amenorrhœa and chlorosis. Locally applied, dissolved in glycerin, it is valued in India as a stimulant application in skin diseases, and for this purpose is generally combined with myrrh, constituting the Musanbar of Bombay.

Hepatic aloes is a species of Arabian aloes, so called from its liver hue. It is duller and more opaque in color than other kinds, more bitter, and has a less pleasant aroma than the Socotrine aloes itself, but it is believed to be the sediment deposited in Socotrine aloe juice.

A. vulgaris, Lamarck and Bauhin; A. vera, Lin.; A. Barbadensis, Miller, has long been cultivated in the Antilles, and furnishes from thence the main supply of the Barbadoes and Curacoa aloes.

This West Indian aloes may at once be distinguished by its disagreeable odor.

There are two varieties met with in commerce, one presenting a brown, the other a black fracture; the former is the best.

The culture in Barbadoes is confined to the small farmers entirely, and is carried on chiefly in the parish of St. Philip, toward the seashore, where the soil is scanty and dry. The produce of an acre of land is about 140 pounds of extract. The plants require to be renewed about every fourth year.

It is this species which Professors Willkolm and Parlatore record as truly wild in countries around the Mediterranean Sea, on the sandy or rocky sea coasts of Spain and Italy. Haworth found the leaves of this and of A. striata more succulent than those of any other aloe.

Barbadoes aloes is usually imported in gourds, breaks with a dull, conchoidal fracture, and has a bitter taste. Socotrine breaks with an irregular or smooth and resinous fracture, has a bitter taste and a strong but fragrant odor.

In my work on "The Commercial Products of the Vegetable Kingdom," published as far back as 1853, I described the production and commerce in aloes, but much information has been published since then. The imports into London have been falling off of late years.

In 1890 the receipts were 7,360 cases and packages and 622 gourds; in 1892 they were only 2,652 cases and 277 gourds.

Anacardium occidentale, Lin.—The trunk and branches of the cashew nut tree yield, on being wounded, during the monthly ascent of the sap, a white and transparent gum, similar to that of arabic. A full-grown tree will furnish an annual amount of ten or twelve pounds. The fresh acid juice of the flower stalks is used in lemonade; wine and vinegar are made by fermenting it.

Anogeissus latifolia, Wall.—The gum from this Indian tree occurs in clear, straw-colored, elongated tears, adhering in masses, sometimes honey-colored, or even brown from impurities. As an adhesive gum it is inferior in strength to gum arabic, in consequence of which it commands a much lower price in Europe, the more so since it is nearly always mixed with the bark of the tree, sand and other impurities.

BALSAMODENDRON SPECIES.

B. Ehrenbergi, Berg.—This species of the deserts of Arabia yields myrrh, and some other species produce the same resin. Professor Oliver unites this with B. opobalsamum, Kunth, which furnishes Mecca or Gilead balsam.

B. africanum, Arnott; Heudelotia africana, Rich.; Amyris niottout, Adans.

African bdellium is translucent, but has a dull fracture. The taste is slightly bitter.

B. kataf, Kunth; Amyris kataf, Forsk., furnishes the gum resin or African bdellium, which reaches Bombay from Berbera, the purer kinds very much resembling myrrh in perfume. The opaque bdellium of Guibourt is used for the extraction of the Guinea worm. It is of a yellowish white color, resembling ammoniacum.

B. mukul, Hooker, of Scinde and Beloochistan, furnishes the Indian bdellium, or "Gugul," which is used in native medicine as a demulcent, aperient, carminative and alterative; especially useful in leprosy, rheumatism and syphilitic disorders. It is also prescribed in nervous diseases, scrofulous affections, urinary disorders and skin diseases, and is employed in the preparation of an ointment for bad ulcers. A fragrant balsam is obtained in Arabia from the fruit of this species. The African bdellium is the product of another species.

B. myrrha, Nees.—This tree of Arabia and Africa yields the myrrh of commerce, which occurs in the form of tears, of irregular shape, of variable size, and of a yellow or reddish yellow color, light, brittle, somewhat translucent, and at times shining. Fracture vitreous or conchoidal, of a bitter aromatic taste and peculiar smell. It contains a volatile oil, was used in ancient times as "frankincense," and is still so employed in China. Myrrh is used as a stimulating medicine, and as an ingredient in tooth powders. Bombay is the chief port at which myrrh is received and shipped. Four kinds are imported there: the African or true myrrh, which is considered the best quality; the Arabian, the Persian (source unknown), and the Siam. On the bags arriving at that port, they are opened and sorted into the different kinds.

The Aden agents of Bombay houses attend the annual fair at Berbera, and exchange goods for the gum resins. The bags or bales, when opened in Bombay, are found to be made up of 1, a large proportion of roundish masses of fine myrrh; 2, of a considerable proportion of small, semi-transparent pieces of myrrh of irregular shape; 3, of numerous pieces of dark colored myrrh, mixed with bark and other refuse; 4, a small proportion of an opaque bdellium. When sorted the best myrrh goes to Europe, the darker pieces form a second quality and the refuse is exported to China, where it is probably used as incense.

Myrrh is beneficial in dyspepsia, amenorrhœa and chlorosis, and a useful astringent to all ulcerations or congestions of the mucous membrane. It makes a valued wash for the mouth and gums and a gargle in ulcerated sore throat. It is a stimulant, expectorant, and much admired as a remedy for pulmonary affections, especially the asthma of the aged. Hakims, in India, use it for intestinal worms. It is detergent, siccative, astringent and aperient, a disperser of cold tumors and one of the most important of medicines, as it preserves the humors from corruption. Dissolved in milk, it is dropped in the eye in purulent ophthalmia. It is useful in humid asthma and chronic catarrh; also in chlorosis and defective menstruation. Dose, in pill, powder or emulsion, 10 to 30 grains; of tincture, ½ to 1 fluid drachm.—Dr. George Watt.

B. opobalsam, Kunth; Amyris opobalsam, Lin.—This tree furnishes the balsam or balm of Gilead, which is not a true balsam, but an oleo-resin of a consistence like that of Chian turpentine. It has a fragrant odor and warm, aromatic taste, and was held in high esteem by the ancients, and accredited with a variety of medicinal properties. As a cosmetic and perfume it is still largely employed by Turkish ladies. There are references to it by many ancient writers, among others, Theophrastus, Dioscorides, Pliny and Galen, and also many mentions of it in the Bible. So highly prized was this balsam that, during the war of Titus against the Jews, two fierce contests took place for the orchards in Jericho where it was produced, the last of which was to prevent the Jews from destroying the trees that the trade might not fall into the enemy's hands. The gardens were taken formal possession of as public property, an imperial guard was appointed to watch over them, and it appeared that the emperor increased their size and endeavored to propagate the plants. The imperial care was unavailing, for not a branch of the balsam tree is now to

* American Journal of Pharmacy.

be found in all Palestine. The shrub was taken to Arabia and grown in a recess in the mountains between Mecca and Medina, whence the balsam is now exported, not as balm of Gilead, but balsam of Mecca. The substance is still eagerly sought for in Egypt and the East under this name. It is obtained by making incisions in the trunk or branches, but the yield is very small, only averaging three or four drops per diem. This fact accounts for the comparative rarity and the great costliness of the genuine article, as also for the numerous substitutes and imitations of the original. There are three qualities produced by art; the first and best is the opobalsam, expressed from the green berry and leaves; the second is the carpobalsam from the ripe seed or berry; and the last is obtained by bruising and boiling the young wood. The twigs, possibly after boiling, are sent to Venice, where they enter into that heterogeneous compound, Venice treacle.

B. Roxburghii, Lin.—This yields a gum resin of a greenish color, moist and easily broken, having a peculiar cedar-like odor.

Boswellia Carterii, Birdwood.—The frankincense of commerce. This stimulating gum resin is also obtained from B. Frereana and other species; it is used medicinally and as a perfumery incense. The European frankincense is, however, distinct, being a resinous exudation from the spruce fir, used in the composition of plasters.

Olibanum consists of tears, often an inch in length, of an ovate or oblong clavate or stalactite form, and mixed with impurities. The pieces are light yellow to brown, pale green or colorless. There are two varieties, one of which is far inferior to the other. The best is found in pieces as large as a walnut, of a high yellowish color, inclining to red or brown, covered on the outside with a white powder, the whole becoming a whitish dust when pounded. It burns with a clear and steady light, not easily extinguished, and diffuses a pleasant balsamic and resinous fragrance. This drug is constantly burnt as incense in the Hindu temples, under the names of "Khounda" or "Kunda" and "Luban," and also in Roman Catholic churches.

Bombay is the port from whence the greatest quantity is exported. England receives from 7,000 to 8,000 packages yearly. Olibanum is rarely used in medicine in Europe, but in India it is regarded as a demulcent, aperient and alterative, acting chiefly on the lungs and as a purifier of the blood. It is there used in rheumatism, nervous diseases, scrofulous affections and skin diseases. It is regarded as a diaphoretic and astringent, and is employed in the preparation of an ointment for carbuncles, boils, ulcerations and other sores. As a fumigating agent, it is employed to overpower unpleasant odors and to destroy noxious vapors.

B. glabra, Roxb., also yields this fragrant resinous substance. It is bitter and pungent; mixed with "ghee" or fluid butter, the native doctors prescribe it in gonorrhœa and other complaints.

B. serrata, Stackh., is sometimes called the Indian olibanum tree. Of this there are two varieties, one being the B. thurifera of Roxburgh and Colebrooke, and the other B. glabra, noticed above. The gum resin occurs as a transparent golden yellow, semi-fluid substance, which hardens with time. It has a slightly aromatic and balsamic resinous odor.

B. Thurifera, Coleb.; B. serrata, Stackh.—This and some other species yield the gum resin. It has astringent and stimulant properties. Externally, it is useful as a rubefacient and antispasmodic, especially as a plaster in cramps of the stomach.

Butea frondosa, Roxb.—This Indian tree—the Dhak or Pulas—yields a gum which is sold as Bengal kino. It occurs in the form of fragmentary pieces of a deep claret color, mixed with similarly shaped particles of gray bark. The purer qualities are met with in round tears, often bright claret colored and free from dirt. It may be purified by solution in water. The brilliant ruby-red colored tears are translucent and very brittle, heat rendering them more so, instead of melting the gum. With age, it darkens, and becomes opaque. In native medicine, in India, it is largely used as an astringent.

Camphora officinarum, Nees.—The aggregate exports of camphor from China have increased considerably of late years. They were 22,231 cwt. in 1892, and 40,763 cwt. in 1893. The island of Formosa yields the principal quantities, the yearly output being now as much as 41,650 cwt., shipped from the ports of Tamsui and Tainan. The exports from Japan range from 3,000,000 to 4,500,000 cattsen = 35,714 cwt. to 53,571 cwt.

Malay or Borneo camphor is obtained from Dryobalanops aromatica. The imports of crude camphor into the United States seem on the decline, having been 2,857,222 lb. in 1887, and but 1,733,425 lb. in 1893.

Canarium commune, Lin.—This tree yields the concrete resinous exudation known as Manila elemi. It has a fragrant, fennel-like odor, and is usually soft and unctuous to the touch. Its medicinal properties are analogous to those of turpentine, and it is for external use only. It is said, however, to have the same properties as copaiva.

C. edula, of Africa, exudes a similar resin.

C. strictum, Roxb.—The black dammar tree, yields a brilliant resin, which is used medicinally in India as a substitute for Burgundy pitch.

Carica papaya, Lin.—This tree has several valuable medicinal properties. The milky juice is among the best vermifuges known. The natives in India repeatedly use it for children. In the West Indies the powder of the seeds is used for the same purpose. The juice of the fruit is said to destroy freckles on the skin, caused by the sun's heat, and the negroes employ the leaves to wash linen, instead of soap. The fruit is pickled and preserved for curries. The milky, viscid juice of the fruit has a singular effect in rendering meat tender. It has this effect even if the meat is hung under the tree for two or three hours.

Cedrus Dedara, Loudon.—This tall, handsome Indian tree yields a true resin, and, by destructive distillation, a dark-colored oil, resembling tar, which is used medicinally.

Cistus Creticus, Lin.

Labdanum, or Ladanum, is a viscous, resinous exudation from the above species, and also to some extent from C. ladaniferus, L., C. Ledon, Lam., C. laurifolius, L., and C. monspiliensis, Lin. It is black brown, soft, of pleasant smell and bitter taste, and was once in high repute in medicine as a stimulant and expectorant, and recommended in chronic catarrh; but at present is chiefly used in perfumery. About 50 cwt. are annually collected in Crete, and some quantity also in Cyprus, and sent to Constantinople. Labdanum was formerly regarded by the Turks as a preventive against the plague, and they wore pieces as amulets, or affixed to their walking-sticks. They chiefly use it now for fumigation.

Cochlospermum Gossypium, DeC.—This tree and Sterculia urens yield a clear white gum, which can be employed as a substitute for tragacanth, and is exported to America. It is issued to the government hospitals in Bombay instead of tragacanth, and is largely used in that city in the manufacture of sweetmeats.

Commia Cochinchinensis, Lour.—This tree yields a white tenacious gum, of an emetic, purgative, deobstruent nature. If prudently administered, it is useful in obstinate dropsy and obstructions.

Copaifera Lansdorffii, Desf.—This and some other species (C officinalis, Lin., C. Martii, Hayne, C. Guianensis, Desf., and C. coriacea, Mart.) are believed to yield the medicinal oleo-resin. It is obtained chiefly from the Amazon district, by making incisions in the tree, and the sap flows so abundantly that as much as 12 pounds weight is collected in a few hours, and 42 quarts during the season. The source of copaiba is usually given as C. multijuga, but this is very questionable. In its medicinal action, copaiva is of great value as a diuretic and stimulant remedy in certain affections of the bladder and urethra; also in chronic bronchitis and other affections of the lungs and air passages, attended with excessive secretion. It has likewise been found serviceable in some chronic skin diseases, as leprosy and psoriasis. The imports into London are included with other balsams, therefore the quantity cannot be given. The imports into the United States, however, were, in 1888, 132 262 pounds; in 1889, 163,624 pounds; and in 1890, 206,240 pounds.

Dichopsis Gutta, Bentham; Isonandra Percha, Hooker; Isonandra Gutta, Lind.; Palaquium Gutta, Baillon and Burck.—Gutta percha, although chiefly employed for various economic purposes, has also a few medicinal and surgical applications. Sheets softened in water, when applied to injured limbs, harden and form good splints; dissolved in chloroform, it is applied as a dressing for wounds, and various surgical instruments are made of it. The imports into Great Britain in 1890 were 70,162 cwt., of the value of nearly £800,000, and in 1893, 40 497 cwt., valued at £303,593.

Dipterocarpus laevis, Ham.

The wood oil known in all the Indian bazaars as "Gurgun," is obtained by tapping certain trees of this order, and applying heat to the incision. Several species yield the oil, which has all the medical properties of some of the more esteemed balsams, especially as a substitute for copaiva, in gonorrhœa and certain skin diseases.

D. incanus, Roxb., is reported to furnish the largest proportions of the best sort. The following is Roxburgh's account of the manner of obtaining this oil from D. turbinatus, Gaert.: "This tree is famous over all the eastern parts of India and the Malay Islands, on account of its yielding a thin, liquid balsam, commonly called 'wood oil,' which is much used in painting ships, houses, etc. To procure the balsam a large notch is cut into the trunk of the tree, near the earth, and say about 30 inches from the ground, where a fire is kept up until the wood is charred, soon after which the liquid begins to ooze out. A gutter is cut in the wood to conduct the liquid into a vessel placed to receive it. The average product of the best trees during the season is said to be sometimes 40 gallons. It is found necessary, every three or four weeks, to cut off the old charred surfaces, and burn them afresh; in large, healthy trees abounding in balsam, they even cut a second notch in some other part of the tree, and char it as the first. These operations are performed from November to February. Should any of the trees appear sickly the following season, one or more years respite is given them."

This oleo-resin has been used in the cure of leprosy. Large quantities are exported from Burma to Europe, as it has become an important drug in trade. From the port of Hankow, in China, in 1893, 403,200 cwt. of this oil was exported.

Dorema ammoniacum, Don.

Diserneston gumiferum, Sp. and Jaub.

Peucedanum ammoniacum, Nees.

This fetid gum resin, having properties similar to asafetida, comes in mass and in tears from Persia.

Lump ammoniacum resembles galbanum, while that in tears is somewhat like olibanum, but has a smooth surface outside, and an opaque fracture. It is used in medicine as an antispasmodic, stimulant and expectorant, in chronic catarrh, bronchial affections and asthma, and also for some plasters.

The imports into London are not large, and average about 100 packages, but fluctuate; in 1891 only 46 packages were received, but in 1892, 279 cases of 1½ cwt. each, and in 1893, 45 cases.

It is called "Uschekh" in Persia; in that country it is much used as an inward medicament, and also frequently for greasing the spinning wheels, as it is very cheap.

Dracæna species.—The dragon's blood of Africa has been known in medicine from the earliest historical times. About 200 chests in mass or blocks come into London yearly. It is the resinous exudation of several different plants, is dark red-brown, and, when pulverized, carmine red, without taste or smell.

The African from Somaliland is yielded by D. Schizantha, and that of Socotra by D. Ombet. The resin exudes, after the bark has been scraped, in about a fortnight. The Socotra kind is exported from Aden to Bombay.

Dragon's blood was formerly referred to Dracæna Draco, Lin., and Calamus Draco, Lin. The Sumatra dragon's blood appears in commerce in the form of reeds or sticks about a foot long, wrapped in palm leaves. It is sometimes employed in the composition of tooth powders, but seldom now in medicine. Pterocarpus Draco also yields dragon's blood and other species kino.

Eperua falcata, Aubl., Dimorpha falcata, Swartz.—The Wallaba resin obtained from this tree in Guiana is inflammable and gives a bright light.

Its styptic and curative powers in cuts and bruises are well appreciated by the Indians and other natives of the colony. An oil obtained from the wood is also used as a dressing for incised wounds.

Eucalyptus rostrata, Schlechtendal.—An exudation from this tree is a most invaluable medicine in certain disorders. It exudes in a fluid state from the bark, and in some instances between the different layers of the wood, and by the evaporation of the watery particles by which it is held in solution, it concretes into a beautiful, ruby-colored gum, which, when exposed for a length of time to the air and sun, assumes a black color from an imperfect oxidation, losing at the same time its astringency. This gum is an original astringent principle, analogous in some respects to tannin, the basis of other vegetable astringents, but by no means identical with that compound.

It is more effective than catechu, or Indian kinos, although it contains a less amount of astringent matter.

Dr. J. Sutherland, of Bathurst, Australia, in a communication to my Technologist (vol. 3, p. 69), thus speaks of it:

"As a medicine, it is a more powerful astringent than any in our Pharmacopœias, and justly merits a place among the legitimate articles of the materia medica. I have prescribed it in a variety of disorders in which astringents are indicated, and found it peculiarly serviceable in certain stages of diarrhœa and dysentery, in passive hemorrhage, as an injection in leucorrhœa, gonorrhœa and gleet, in scurvy of the gums; as a gargle when the acute symptoms have subsided, in relaxation of the uvula, in hemorrhoids; in the form of an ointment made by dissolving a drachm of the gum in a teaspoonful of water, and, when intimately mixed, rubbing it up with an ounce of lard. The dose for internal administration varies from one or two grains to twenty, dissolved in water."

Euphorbia officinarum, Lin., or E. resinifera, Berg.—The above, E. canariensis, Lin., and some other fleshy species, produce the saline, waxy resin called in the shops "gum euphorbium," which is the inspissated, milky juice of these plants. It is chiefly obtained in the neighborhood of Mogadore and called "Dergmuce." It is used as a vesicant in veterinary medicine, but is seldom employed otherwise. The inhabitants of the lower regions of the Atlas Range make incisions in the branches of the plant, and from these the milky sap exudes, which is so acrid that it excoriates the fingers when applied to them. This exuded juice hardens by the heat of the sun, and forms a whitish-yellow solid, which drops off in the month of September and forms the euphorbium of commerce. It causes considerable irritation of the nostrils and eyes when powdered. E. Antiquorum, Lin., yields a hydrocarbon, gutta percha like substance, known as "Cattimandoo," which is the Dorf of the Hindus—a much prized medicine.

Feronium elephantum, Corr.; Cratæva Valanga, Kon.—This tree yields a brownish or reddish gum with a small proportion of clear, yellow tears, soluble in water. The Pharmacopœia of India pronounces it as superior to gum arabic for medicinal purposes.

Ficus elastica, Roxburgh; Urostigma elasticum, Miqu.—To give some idea of the vastly increasing extent to which rubber, obtained from various elastic saps, is now required, it may be stated that the British imports of caoutchouc in 1893 were 293,373 cwt., and the United States import even more. The combined imports of India rubber and gutta percha into the United Kingdom in 1893 were about 324,000 cwt. Great Britain also imports about 3,250,000 pounds of rubber manufactures. At Wedzell's factories, in Munden and Hildesheim alone, there were produced, a few years ago, over 100,000 pounds of surgical articles from it.

Fraxinus ornus, Lin.; F. rotundifolia, Lam.; Ornus Europœa, Pers.; or Ornus rotundifolia.—The sweet exudation, known as "manna," is chiefly the concrete juice obtained by incising the bark of the ash and collecting it on pieces of stick, hence called flaky manna. The best is in oblong, light, friable pieces, of a whitish color and somewhat transparent, with a sweetish, sharp taste and a weak smell. The inferior kinds are moist, unctuous and dark colored. It is a mild aperient medicine. Each hektare (of two and one-half acres) planted with the ash—4,000 to 5,000 trees—produces on an average nearly 2,000 pounds of manna. It used to be produced in Calabria, but that exported comes chiefly now from Palermo, in tin boxes weighing about 14 pounds. Small flake manna is sent out in cases of about 120 pounds, large flake manna in cases of half that size. The export of manna from Italy, in 1884, was about 446,000 pounds. Spurious manna is known by its uniform color and freedom from the slight impurities as well as from the peculiar odor and slight bitterness of true manna.

Calabria was, many years ago, the only source of the manna of commerce, but the production there has ceased, and, as stated above, Sicily is now the chief seat of production. Manna is nutritious, particularly when recent. It is a mild laxative, does not excite inflammation, useful for children and delicate females, usually operating mildly, but in some cases produces flatulence and pain.

In certain cases, the leaves of Larix Europœa exude a species of manna called "Manna of Briancon," which is eaten in Russia. Another kind is from Tamarix mannifera, and the Oriental manna of the desert from Albagi maurorum, DeC., A. mannifera, Desf. The sugary secretion obtained naturally from this plant is chiefly collected in Khorasan, Kurdistan and Hamadan, and imported into Bombay. As a medicine its effects correspond to those of the ash manna.

The Arabs who cross the deserts avail themselves of the manna of the camel's thorn (Alhagi camelorum, Fisch.) It is found in the morning on the ground round the plant, during several days of the summer, and is collected before the sun can melt it. It occurs in small, round, unequal grains, the size of coriander seed, of a yellowish white or greenish yellow color, caking together and forming an opaque mass, in which are found portions of the thorns and points of the plant. This manna is inodorous, its flavor is sweetly saccharine, followed by slight acidity. The Khergese use it for various kinds of sweetmeats. The inhabitants collect these exudations and make them into loaves or cakes. These soon become of a black color, owing to a kind of fermentation, produced by the air

and moisture. The flavor of these manna loaves resembles that of senna in taste; they also resemble senna combined with sweetness. These two characters lead one to suppose that this manna is more purgative than nutritive. Some authors, as Hallé and Guillamin, state that this constituted the manna of the Hebrews, but it is more generally supposed that the Lecanora affinis, Eversm, was the substance upon which the Israelites fed in the wilderness.

Some kinds of manna are obtained in Kurdistan from the dwarf oak, tamarisk, and other trees, but are seldom met with in commerce, being used up locally.

A kind of manna is found in small quantities on the branches of the cedar of Lebanon, in the form of transparent, resinous drops, indubitably the result of the puncture of an insect, like the lerp of Australia. The monks collect this manna and prepare with it various electuaries and ointments, which are sold to strangers visiting the monasteries. This cedar manna enjoys a considerable reputation in Syria as a remedy in phthisis.

The imports of manna into the United States were as follows: In 1888, 31,703 pounds; in 1889, 25,246 pounds; and in 1890, 43,509 pounds.

Garcinia, sp.—The yellow gum resin known as gamboge, and used as a pigment and in medicine, is believed to be obtained from different species of this family. From G. cochin chinensis, Chois., G. Morella, Desv., G. pictoria, Roxb., G. Hanburii, Hook. fil. Several Indian species of garcinia seem to furnish gamboge.

It is chiefly received from Siam in the form of pipe or roll, and in cylindrical masses. It has a faint odor, and an acrid, rancid, afterward sweetish taste. It is employed medicinally in the treatment of dropsical affections, amenorrhœa and obstinate constipation, attended with torpidity of the bowels, and has frequently been found effectual in the expulsion of the tape worm. It is a valuable drastic and hydragogue cathartic, and also possesses anthelmintic and diuretic properties. It consists of 75 per cent. of resin and 15 of gum.

On the Continent of Europe it is known as "gum gutte," from the mode of its preparation. When the sap of the tree is in active circulation, the leaves and young branches are broken off, and the yellow juice that flows from the wounds is collected in cocoanut shells, or twisted leaves of the plant itself. This is afterward poured into larger vessels, made of clay, and dried in the sun until it is of a proper consistence.

G. bowa, Roxb., yields a kind of gamboge of a somewhat paler color than that produced by G. Morella.

Gardenia lucida, Roxb.—A fragrant exudation, known in India as "Dikamale resin," is procured from the tops of the branches. It is extensively used in Indian hospitals as a slight dressing for open wounds, to keep away flies from the sores, on account of its strong aroma.

Guaiacum officinale, Lin.—A mechanical resin is obtained from the stem of this tree, called lignum vitæ. It exudes spontaneously, and is partly obtained by extracting with alcohol. The resin is obtained most copiously by wounding the tree, which is usually done in May. Another method is by heat. The trunk and larger limbs being sawn into billets of about three feet in length, an angular hole is bored lengthwise in each, and one end of the billets so placed on a fire that a calabash may receive the melted resin, which runs through the hole as the wood burns. It is also obtained in small quantities by boiling chips or shavings of wood in water, with common salt. The resin swims on the top and may be skimmed off.

The resin is inside reddish or greenish brown, brittle, gray-white when pulverized, turns greenish in the air, has a balsamic odor and a sweetish bitter taste, which is at the same time acrid and irritating to the throat. The resin is chiefly used in gout, chronic rheumatism, etc. A decoction of the capsules, wood or bark, is also used in medicine as a sudorific. A tincture made of the resin diluted with water is used to cleanse the mouth, strengthen the gums and relieve the toothache.

The British imports are small, seldom exceeding thirty or forty packages in a year. The guaiacum in tears is supposed to be the product of G. sanctum, Lin.

Humirium floribundum, Mart.—This plant, in Brazil, yields from its trunk, when wounded, a fragrant, limpid, pale yellow balsam, called Umiri, possessing the same medicinal qualities as balsam of copaiva. It is used by the natives for gonorrhœa, chronic cystitis, bronchitis, and all diseases attended with excessive secretion. A decoction of the bark is used as a remedy for coughs and derangement of the stomach. Another species, H. balsamiferum, Aubl., yields a similar balsam in Guiana.

Hymenæa Courbasil, Lin.—A fine, transparent, fragrant gum resin exudes from this tree. In solution it has been given internally in doses of a teaspoonful for rheumatic and pseudo-syphilitic complaints, and employed externally as an embrocation. In Brazil the resin is mixed with sugar and rum, so as to make an agreeable emulsion or sirup, which is administered in tedious coughs, weakness of the lungs, spitting of blood and incipient phthisis pulmonalis. A decoction of the inner bark is said to act as a vermifuge.

Icica Tacamahaca, Kth.—The fragrant, bitter resin of the above species is used in Brazil for making ointments. Another Tacamahaca from Elaphrium tomentosa, Jacqu., fetches in Mexico $1 a pound. The resin of Icica heptaphylla, Aubl., in Venezuela, takes the properties of thus. When liquid it is a valuable remedy for coughs. A decoction of the bark is an emetic in fevers. The Callophyllum Calaba, Lin., yields East Indian Tacamahaca.

Icica icicariba, DeC., produces a great deal of the resin passing under the name of "Almaciga," which is much used in medicine and the arts. It is found in the provinces of Maranham, Para and Amazon, in Brazil. Another Icica, known as "Pave de brea," also furnishes it in the same provinces. Some of the resin known as Almaciga is said to be furnished by Bursera balsamifera, Pers., Hedwigia balsamifera, Sw., and is aromatic like incense. Elemi proper is from I. icicariba, DeC., and I. araconchini, Aubl., but is often replaced by the resin of other species of the same genus. The odorous resin which exudes from the trunk gives off, in burning, a lively, agreeable odor. This is used as incense in the churches of French Guiana. It is sometimes used medicinally as balsam of Araconchi, but there is little demand for it in commerce. On wounding the bark of the Jamaica birch (Bursera gummifera, Jacq.), a white, resinous sap exudes, which soon hardens and is in no way different from gum elemi.

Elaphrium Jacquinianum and E. elemiferum, natives of Mexico, also produce a fragrant balsamic, glutinous resin, which furnishes one of the sorts of elemi. Elemi is very friable, and, when heated, puffs up and melts. In boiling water it agglomerates without melting; slightly soluble in ether, insoluble in acetic acid and caustic soda, slightly soluble in carbonic sulphide, soluble in turpentine, slightly soluble in boiling linseed oil, benzine and oil of naphtha. Sulphuric acid dissolves it, coloring it a dark bister; nitric acid colors it a dirty yellow without dissolving it, and ammonia does not act upon it.

What is known as Manila elemi is believed to be a resinous exudation from Canarium commune, Lin. In burning, elemi gives out a lively and agreeable odor; hence it is used for incense in some churches.

(To be continued.)

THE SPLASH OF A DROP AND ALLIED PHENOMENA.*

By Prof. A. M. WORTHINGTON, M.A., F.R.S.

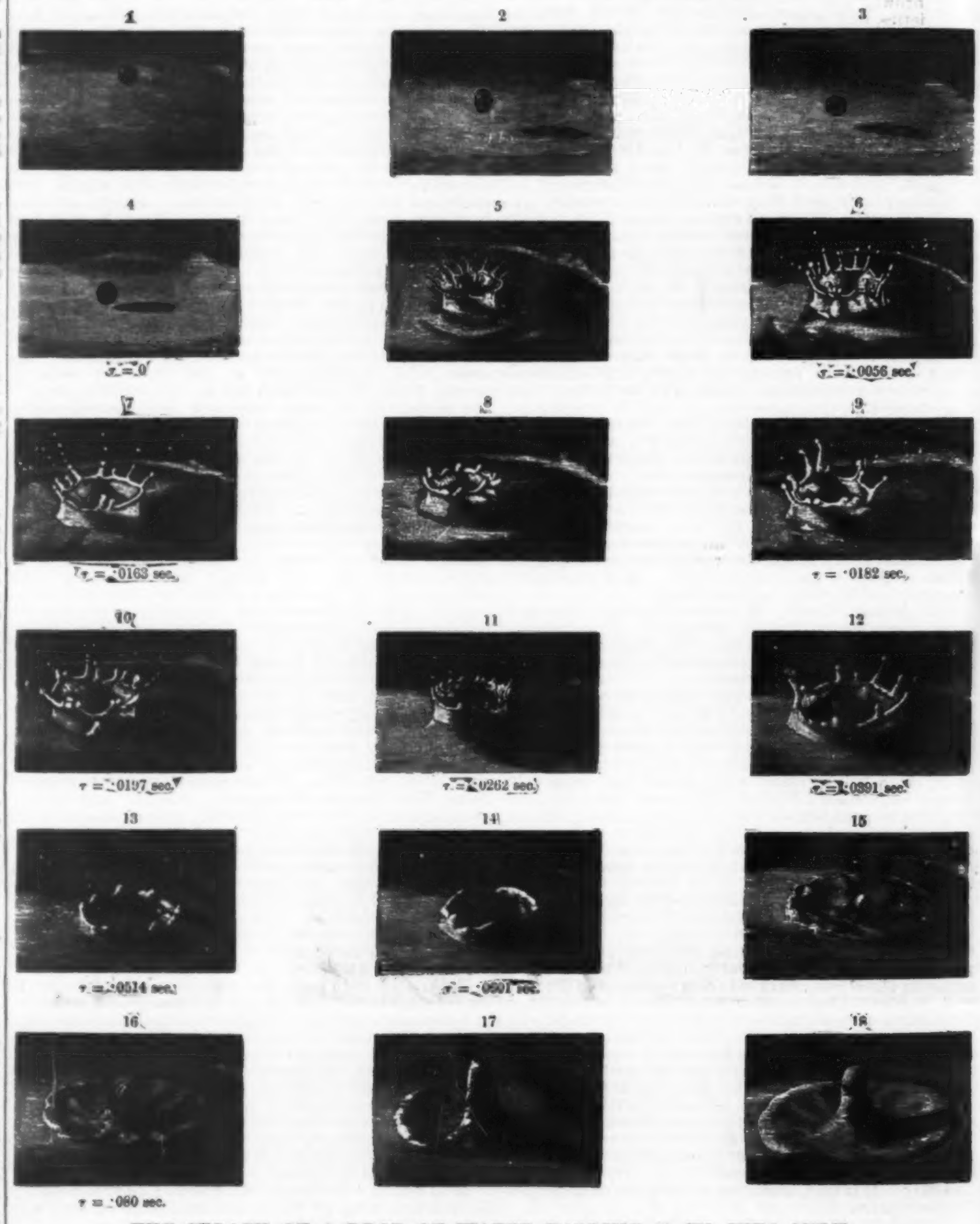
THE splash of a drop is a transaction which is accomplished in the twinkling of an eye, and it may seem to some that a man who proposes to discourse on the matter for an hour must have lost all sense of proportion. If that opinion exists, I hope this evening to be able to remove it and to convince you that we have to deal with an exquisitely regulated phenomenon, and one which very happily illustrates some of the fundamental properties of fluids. It may be mentioned also that the recent researches of Lenard, in Germany, and J. J. Thomson, at Cambridge, on the curious development of electrical charges that accompanies certain kinds of splashes, have invested with a new interest any examination of the mechanics of the phenomenon. It is to the mechanical and not to the electrical side of the question that I shall call your attention this evening.

The first well directed and deliberate observations on the subject that I am acquainted with were made by a schoolboy at Rugby, some twenty years ago, and were reported by him to the Rugby Natural History Society. He had observed that the marks of accidental splashes of ink drops that had fallen on some smoked glasses with which he was experimenting presented an appearance not easy to account for. Drops of the same size falling from the same height had made always the same kind of mark, which when carefully examined with a lens showed that the smoke had been swept away in a system of minute concentric rings and fine striæ. Specimens of such patterns, obtained by letting drops of mercury, alcohol and water fall on to smoked glass, are thrown on the screen, and the main characteristics are easily recognized. Such a pattern corresponds to the footprints of the dance that has been performed on the surface, and though the drop may be lying unbroken on the plate, it has evidently been taking violent exercise, and were our vision acute enough, we might observe that it was still palpitating after its exertions.

A careful examination of a large number of such footprints showed that any opinion that could be formed therefrom of the nature of the motion of the drop must be largely conjectural, and it occurred to me about eighteen years ago to endeavor by means of the illumination of a suitably timed electric spark to watch a drop through its various changes on impact.

The reason that with ordinary continuous light nothing can be satisfactorily seen of the splash is not that the phenomenon is of such short duration, but because the changes are so rapid that before the image of one stage has faded from the eye the image of a later and quite different stage is superposed upon it. Thus the resulting impression is a confused assemblage of all the stages, as in the photograph of a person who has not sat still while the camera was looking at him. The problem to be solved experimentally was therefore this: To let a drop of definite size fall from a definite height in comparative darkness on to a surface, and to illuminate it by a flash of exceedingly short duration at any desired stage, so as to exclude all the stages previous and subsequent to the one thus picked out. The flash must be bright enough for the image of what is seen to remain long enough on the eye for the observer to be able to attend to it, even to shift his attention from one part to another, and thus to make a drawing of what is seen. If necessary, the experiment must be capable of repetition, with an exactly similar drop falling from exactly the same height, and illuminated at exactly the same stage. Then, when this stage has been sufficiently studied, we must be able to arrange with another similar drop to illuminate it at a rather later stage, say $\frac{1}{1000}$ second later, and in this way follow step by step the course of the whole phenomenon.

The apparatus by which this has been accomplished



THE SPLASH OF A DROP OF WATER FALLING 40 CM. INTO MILK.
Scale about 0·6 of actual size.

* Abstract from a paper read before the Royal Institution.

is on the table before you. Time will not suffice to explain how it grew out of earlier arrangements very different in appearance, but its action is very simple and easy to follow by reference to the diagram (Fig. 1).

A A' is a light wooden rod rather longer and thicker than an ordinary lead pencil, and pivoted on a hori-

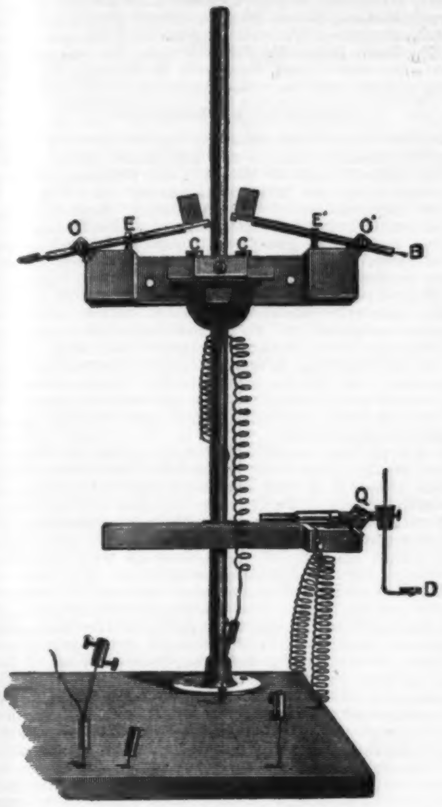


FIG. 1.

zontal axle, O. The rod bears at the end, A', a small deep watch glass, or segment of a watch glass, whose surface has been smoked, so that a drop even of water will lie on it without adhesion. The end, A, carries a small strip of tinned iron, which can be pressed against and held down by an electromagnet, C C'. When the current of the electromagnet is cut off the iron is released, and the end, A', of the rod is tossed up by the action of a piece of India rubber stretched catapult-wise across two pegs at E, and by this means the drop resting on the watch glass is left in midair free to fall from rest.

B B' is a precisely similar rod worked in just the same way, but carrying at B a small horizontal metal ring, on which an ivory timing sphere of the size of a child's marble can be supported. On cutting off the current of the electromagnet, the ends A' and B' of the two levers are simultaneously tossed up by the catapults, and thus drop and sphere begin to fall at the same moment. Before, however, the drop reaches the surface on which it is to impinge, the timing sphere strikes a plate, D, attached to one end of a third lever pivoted at Q, and thus breaks the contact between a platinum wire bound to the under side of this lever and another wire crossing the first at right angles. This action breaks an electric current which has traversed a second electromagnet, F (Fig. 2), and releases the iron armature, N, of the lever, N P, pivoted at P, thus enabling a strong spiral spring, G, to lift a stout brass wire, L, out of mercury, and to break at the surface of the mercury a strong current that has circulated round the primary circuit of a Ruhmkorff's induction coil; this produces at the surface of the mercury a bright self-induction spark in the neighborhood of the splash, and it is by this flash that the splash is viewed. The illumination is greatly helped by surrounding the place where the splash and flash are produced by a white cardboard inclosure, seen in Fig. 2, from whose walls the light is diffused.

It will be observed that the time at which the spark is made will depend on the distance that the sphere has to fall before striking the plate, D, for the subsequent action of demagnetizing F and pulling the wire, L, out of the mercury in the cup, H, is the same on each occasion. The modus operandi is consequently as follows: The observer, sitting in comparative but by no means complete darkness, faces the apparatus as it appears in Fig. 2, presses down the ends, A' B', of the levers first described, so that they are held by the electromagnet, C (Fig. 1). Then he presses the lever, N P, down on the electromagnet, F, sets the timing sphere and drop in place, and then by means of a bridge between two mercury cups, short-circuits and thus cuts off the current of the electromagnet, C. This lets off drop and sphere and produces the flash. The stage of the phenomenon that is thus revealed having been sufficiently studied by repetition of the experiment as often as may be necessary, he lowers the plate, D, a fraction of an inch, and thus obtains a later stage. Not only is any desired stage of the phenomenon thus easily brought under examination, but the apparatus also affords the means of measuring the time interval between any two stages. All that is necessary is to know the distance that the timing sphere falls in the two cases. Elementary dynamics then give us the interval required. Thus, if the sphere falls one foot, and we then lower D ¼ inch, the interval between the corresponding stages will be about 0·0026 second.

Having thus described the apparatus, which I hope shortly to show you in action, I pass to the information that has been obtained by it.

This is contained in a long series of drawings, of which a selection will be presented on the screen. The first series that I have to show represents the splash of a drop of mercury 0·15 in. in diameter that has fallen 3 in. on to a smooth glass plate. It will be noticed that, very soon after the first moment of impact, minute rays are shot out in all directions on the surface. These are afterward overflowed or united, until, as in Fig. 8, the outline is only slightly rippled. Then (Fig. 9) main rays shoot out, from the ends of which in some cases minute droplets of liquid would split off, to be left lying in a circle on the plate, and visible in all subsequent stages. By counting these droplets when they were thus left, the number of rays was ascertained to have been generally about 24. This exquisite shell-like configuration shown in Fig. 9 marks about the maximum spread of the liquid, which, subsiding in the middle, afterward flows into an annulus or rim with a very thin central film, so thin, in

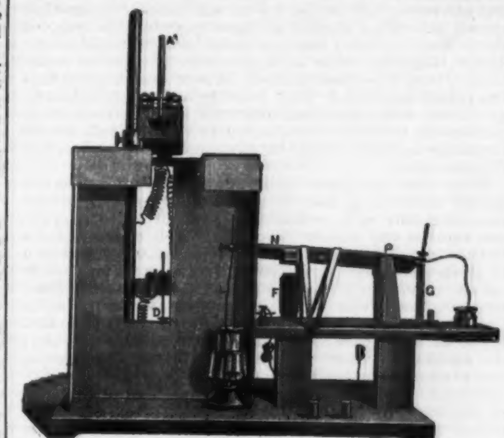
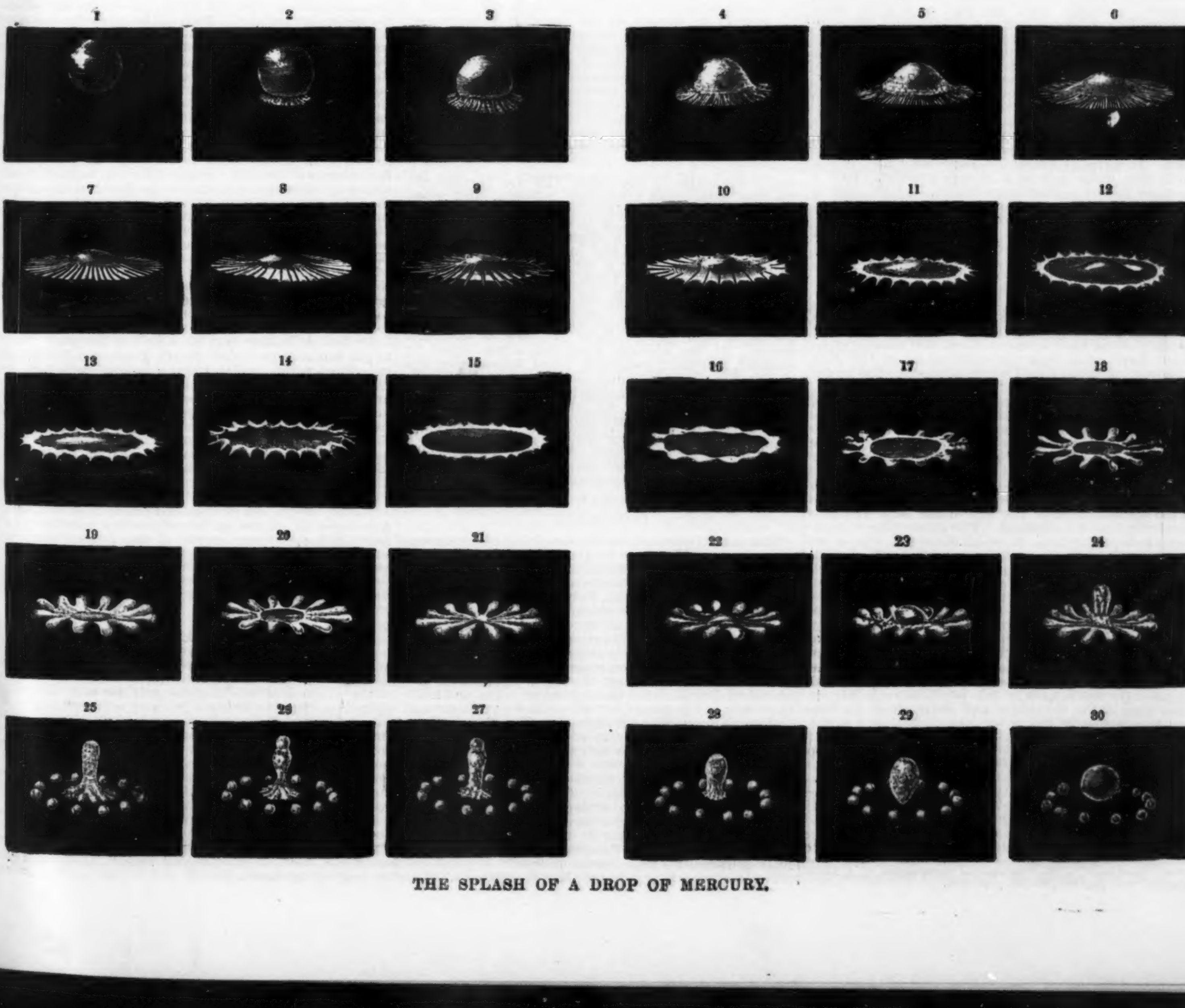


FIG. 2.

fact, as often to tear more or less irregularly. This annular rim then divides or segments (Figs. 14, 15, 16) in such a manner as to join up the rays in pairs, and thus passes into the twelve-lobed annulus of Fig. 16. Then the whole contracts, but contracts most rapidly between the lobes, the liquid then being driven into and feeding the arms, which follow more slowly. In Fig. 21 the end of this stage is reached, and now the arms, continuing to come in, the liquid rises in the center; this is, in fact, the beginning of the rebound of the drop from the plate. In the case before us the drops at the ends of the arms now break off (Fig. 25), while the central mass rises in a column which just fails itself to break up into drops, and falls back into the middle of the circle of satellites, which, it will be understood, may in some cases again be surrounded by a



THE SPLASH OF A DROP OF MERCURY.

second circle of the still smaller and more numerous droplets that split off the ends of the rays in Fig. 9. The whole of the thirty stages described are accomplished in about one-twentieth of a second, so that the average interval between them is about one six hundredth of a second.

It should be mentioned that it is only in rare cases that the subordinate drops, seen in the last six figures, are found lying in a very complete circle after all is over, for there is generally some slight disturbing lateral velocity which causes many to mingle again with the central drop, or with each other. But even if only half or a quarter of the circle is left, it is easy to estimate how many drops, and, therefore, how many arms, there have been. It may be mentioned that sometimes the surface of the central lake of liquid, Figs. 14, 15, 16, 17, was seen to be covered with beautiful concentric ripples, not shown in the figures.

The question now naturally presents itself, Why should the drop behave in this manner? In seeking the answer it will be useful to ask ourselves another question. What should we have expected the drop to do? Well, to this I suppose most people would be inclined, arguing from analogy with a solid, to reply that it would be reasonable to expect the drop to flatten itself, and even very considerably flatten itself, and then, collecting itself together again, to rebound, perhaps as a column such as we have seen, but not to form this regular system of rays and arms and subordinate drops.

Now this argument from analogy with a solid is rather misleading, for the forces that operate in the case of a solid sphere that flattens itself and rebounds are due to the bodily elasticity which enables it not only to resist, but also to recover from any distortion of shape or shearing of its internal parts past each other. But a liquid has no power of recovering from such internal shear, and the only force that checks the spread, and ultimately causes the recovery of shape, is the surface tension, which arises from the fact that the surface layers are always in a state of extension and always endeavoring to contract. Thus we are at liberty when dealing with the motions of the drop to think of the interior liquid as not coherent, provided we furnish it with a suitable elastic skin. Where the surface skin is sharply curved outward, as it is at the sharp edge of the flattened disk, there the interior liquid will be strongly pressed back. In fact, the process of flattening and recoil is one in which energy of motion is first expended in creating fresh liquid surface, and subsequently recovered as the surface contracts. The transformation is, however, at all moments accompanied by a great loss of energy as heat. Moreover, it must be remembered that the energy expended in creating the surface of the satellite drops is not restored if these remain permanently separate. Thus the surface tension explains the recoil, and it is also closely connected with the formation of the subordinate rays and arms. To explain this it is only necessary to remind you that a liquid cylinder is an unstable configuration. As you know, any fine jet becomes beaded and breaks into drops, but it is not necessary that there should be any flow of liquid along the jet; if, for example, we could realize a rod of liquid of the shape and size of this ruler and liberate it in the air, it would not retain its cylindrical shape, but would segment or divide itself up into a row of drops regularly disposed according to a definite and very simple numerical law, viz., that the distance between the centers of contiguous drops would be equal to the circumference of the cylinder. This can be shown by calculation to be a consequence of the surface tension, and the calculation has been closely verified by experiment. If the liquid cylinder were liberated on a plate, it would still topple into a regular row of drops, but they would be further apart; this was shown by Plateau. Now imagine the cylinder bent into an annulus. It will still follow the same law,* i. e., it will topple into drops just as if it were straight. This I can show you by a direct experiment. I have here a small thick disk of iron, with an accurately planed face and a handle at the back. In the face is cut a circular groove, whose cross section is a semicircle. I now lay this disk face downward on the horizontal face of the lantern condenser, and through one of two small holes bored through to the back of the disk I fill the groove with quicksilver. Now, suddenly lifting the disk from the plate, I release an annulus of liquid, which splits into the circle of very equal drops which you see projected on the screen. You will notice that the main drops have between them still smaller ones, which have come from the splitting up of the thin cylindrical necks of liquid which connected the larger drops at the last moment.

Now this tendency to segment or topple into drops, whether of a straight cylinder or of an annulus, is the key to the formation of the arms and satellites, and indeed to much that happens in all the splashes that we shall examine. Thus in Fig. 12 we have an annular rim, which in Figs. 13 and 14 is seen to topple into lobes by which the rays are united in pairs, and even the special rays that are seen in Fig. 9 owe their origin to the segmentation of the rim of the thin disk into which the liquid has spread. The proceeding is probably exactly analogous to what takes place in a sea wave that curls over in calm weather on a slightly sloping shore. Any one may notice how, as it curls over, the wave presents a long, smooth edge, from which at a given instant a multitude of jets suddenly shoot out, and at once the back of the wave, hitherto smooth, is seen to be furrowed or "combed." There can be no doubt that the cylindrical edge topples into alternate convexities and concavities; at the former the flow is helped, at the latter hindered, and thus the jets begin, and special lines of flow are determined. In precisely the same way the previously smooth circular edge of Fig. 8 topples, and determines the rays and lines of flow of Fig. 9.

TRANSFERRING GASES TO VACUUM TUBES.

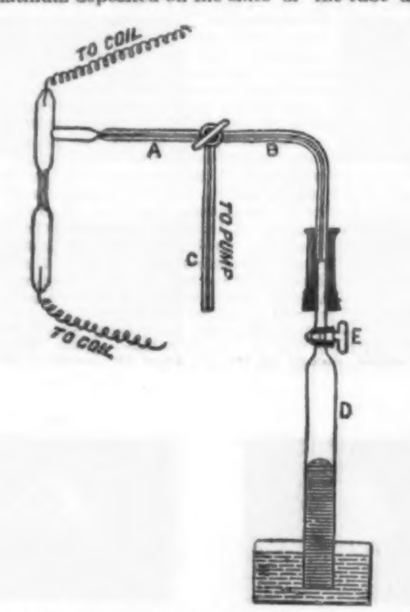
By James Young, A.R.C.S., F.C.S., and Charles R. Darling, Wh. Sc., A.R.C.S. (Ireland).

While engaged in an examination of the gases evolved by certain minerals, we found it necessary to devise a method of filling vacuum tubes, using small quantities of gas so as to recover all excess. The subjoined sketch shows the method adopted, and which we found to be more convenient than any other method we have tried.

A three-way capillary tap has one of its arms, B, bent at right angles. The tube, D, containing the gas to be admitted over mercury, and possessing a plain tap, E, is connected to B by means of a mercury joint. Both taps must be perfectly vacuum tight. The arm, C, is connected with the Sprengel or other pump, while the arm, A, is fused to the side piece of the vacuum tube, which latter is made of sufficient length to allow of convenient fusion. After joining to A, the side piece is drawn out so that it may be readily sealed off after filling. The operation is then conducted as follows: The three-way tap is turned so as to connect A and C, and pumping continued until as good a vacuum as possible is obtained. The tap, E, being closed, B and C are then connected, and the space between the two taps pumped free of air. The tap is now turned so as to connect A and B, and the tap, E, turned on, so as to admit a little of the gas into the vacuum tube. The arms, A and C, are again connected, and the excess of gas pumped out and collected over mercury at the bottom of the fall tube, all loss being thus avoided. This process is repeated two or three times to wash out the tube. The tubes may be sparked in situ, so that the pumping may be discontinued at any desired moment, and the tube sealed off.

We may mention that in a specimen of samarskite examined the residual gas obtained, after exploding with oxygen (to remove hydrogen and a hydrocarbon present), absorbing with potash, and removing excess of oxygen with alkaline pyrogallol, was found to be pure nitrogen. This was mixed with oxygen, and sparked for a considerable time over potash. There was a steady diminution of volume during the sparking; but at no period could any trace of helium be detected spectroscopically.

While sparking the tubes with a strong current, with a fairly high vacuum, we obtained brilliant mirrors of platinum deposited on the sides of the tube adjacent to the platinum electrodes. This was particularly the case with those containing nitrogen, and when several strands of thin platinum wire twisted together were used as electrodes. With a single piece of thick wire as electrode, only a slight blackening was obtained. With hydrogen and oxygen, using the same current, there was only a very slight deposit in all cases. In the nitrogen tubes, when the deposit attained a certain density, the current flashed across radially from the electrodes, and after a time began to eat away the mirror from the edges, redepositing a portion of it on the walls of the tube at the dark spaces. At the moment when the mirror began to conduct, a brilliant yellowish green fluorescence was observed in the glass which was scarcely visible previously. We have also noticed the phenomenon mentioned by Prof. Ramsay, viz., that with the deposition of the mirrors in nitrogen tubes the gas appears to be carried down by the platinum, a very high vacuum being in some cases obtained, which refused to allow the passage of the current.—Chem. News.



* See Worthington on the "Spontaneous Segmentation of a Liquid Annulus," Proc. Roy. Soc., No. 200, p. 49 (1879).

THE INTERNATIONAL GEOGRAPHICAL CONGRESS.

The sixth International Geographical Congress was formally constituted by the Duke of York, one of the five honorary vice-presidents, in the name of the patron, the Queen, and of the vice-patron, the Prince of Wales. At 9 o'clock a. m., July 26, the delegates from governments and geographical societies assembled in the east conference hall at the Imperial Institute.

The visitors wore decorations and orders and were ranged according to their respective countries. The ceremony of presentation began as soon as the Duke of York entered the room. As the delegates were presented they filed out of the conference room and made their way to the great hall, where already a large and brilliant company had assembled. His Royal Highness delivered his address of welcome in clear and measured tones audible in every part of the great hall.

On its conclusion, Mr. Clements Markham, as president of the congress, gave a warm welcome to his fellow geographers, on whose behalf Chief Justice Daly, of New York, the doyen of the presidents of the geographical societies of the world, replied in a felicitous speech. On Saturday morning Mr. Markham delivered his presidential address.

The audience that greeted Mr. Markham when he rose to deliver his address was brilliantly representative. Among those present were Prince Roland Bonaparte, Professor Vambéry, Dr. Neumayer, of Hamburg, Chief Justice Daly, of New York, Mr. Paul du Chaillu, Dr. Karl von den Steinen, Professor Levasseur, Senhor Luccano Cordeiro, Dr. Danckelmann, Geheimrath Haucheeorne, Professor Forel, Professor Pettersson, Mr. Andrée, Mr. W. W. Rockhill, General Greely, Professor Libby, Colonel Haffner, Professor Yngvar Nielson, Baron Dhanis, Count Joachim Pfeil, Captain Francisco Ferreira de Amaral, Professor Wagner, Professor Rein, Professor Penck, Dr. Supan, of Gotha, Dr. Oscar Lenz, Professor H. Cordier, M. Bouget de la Grye and Count de Bizemont.

ANTARCTIC EXPLORATION.

The Arctic and the Antarctic regions between them occupied the attention of the assembled geographers for the greater part of Monday, the discussion being introduced by an admirable paper on "The Scientific Exploration of the Antarctic Regions," by Geheimrath Dr. George Neumayer, of Hamburg, certainly one of the greatest authorities in Europe on the subject. Dr. Neumayer read the first part of his paper in German and the latter portion in English. Dr. Neumayer's proposal was that the work of South Polar exploration should be made a matter of international co-operation. To the discussion that followed the reading of Dr. Neumayer's paper Dr. John Murray, of the Challenger, made a most interesting contribution. Dr. Murray has already thrown himself with characteristic zeal into the movement for inducing the British government to undertake a great Antarctic expedition.

In his address he said that with regard to the condition of the Antarctic regions the indications were rather those of a real continent than of a chain of volcanic islands. During the voyage of the Challenger they brought up a considerable quantity of deposits now forming at the bottom of this area, and they found all sorts of rocks, such as were found in traveling over the European continent. He believed the Norwegian gentleman who had quite recently landed at Cape Adair, and was the first man, perhaps, who had put his foot upon the earth of the Antarctic continent, had brought home some cryptogamic organisms, which, it was believed, were very much the same as those Sir Joseph Hooker found years ago. He commented further upon the important meteorological questions that remained to be settled by investigation of these regions. If Sir James Clark Ross was able to penetrate the part of the Antarctic region to the west of Victoria Island on two successive occasions in a ship without steam, and if a small steamship had been able to penetrate into the same place, he thought possibly the indications were that the winds blew from the south so as to free that region from ice and made it clear almost every season. Remarking on some of the results achieved by the Challenger expedition in the Antarctic seas, Dr. Murray said that the amount of life found in this Antarctic region to the south of latitude 40° was very much more abundant than in any other part of the world. It was not at all impossible that one of the great secrets of oceanic circulation was to be found by investigation of these regions. Certainly one of the greatest pieces of scientific and oceanographical work yet to be done on the surface of the globe awaited their efforts in the Antarctic regions. If the civilized nations of the world were to spend their wealth in the highest and best manner, then he thought that they should give their sympathy toward the completion of this great piece of scientific work before the close of the present century. (Cheers.) He thought the exploration should be undertaken by the navies of the world. It could not be done by private enterprise, unless they could get two or three millionaires each to subscribe a million. (Laughter.) We ought to lead in the matter, and if we made the start, he had no doubt some of the other civilized nations would follow. (Cheers.) His idea was that in the first instance ships should make a preliminary survey of the ice. After that he did not think there would be much risk in landing a certain number of men from these naval expeditions and establishing observatories, which might be carried on for two winters, communication being held with the explorers during the summer. He hoped that the first step taken by the congress in regard to this matter would be to appoint a small committee to draw up a resolution on the subject to be passed by the congress as a whole.

Sir Joseph Hooker lent the weight of his great name to the demand for a new South Polar expedition, an expedition which, as Dr. Murray insisted, was beyond the capacity of private individuals or corporations, and to be successful must be national or international in its character, backed up by the resources of the treasury and the ships of the Royal Navy. As a practical outcome of the discussion a committee was appointed to frame a resolution to be submitted to the congress before it disperses.

THE NORTH POLE BALLOON PROJECT.

To the Arctic regions several papers were devoted. Admiral A. H. Markham introduced the subject in an essay giving a general survey of the present state of our knowledge of the Arctic regions. General Greely's paper "On the Scope and Value of Arctic Exploration" dealt with the results which had been attained, both from a commercial and from a scientific point of view, by polar exploration in the past, and he paid generous testimony to the great part which British sailors and explorers had taken in the work. It was, however, in Herr S. A. Andrée's promised explanation of his project for reaching the North Pole by the aid of a balloon that the keenest interest centered.

The problem of reaching the pole, he said, or generally speaking, to make a journey across the Arctic deserts, was not a purely scientific, but a technical problem. The results to be achieved were, of course, of prime importance to science, whereas it belonged to the engineer to devise the means by which the desired end was to be accomplished. Herr Andrée then stated as follows the requirements for a successful balloon expedition to the North Pole:

1. The balloon should be of sufficient carrying power to enable it to carry three persons, together with all necessary instruments for making observations, provisions, etc., for four months, and ballast, all estimated to weigh about 3,000 kg.

2. The balloon should be of such impermeability that it could be kept afloat for a period of 30 days.

3. The filling of the balloon must take place somewhere in the Arctic region.

4. The balloon should be steerable to a certain extent.

He first explained how the first two requirements had been fulfilled by the arts. As to filling the balloon in the Arctic, he continued, no technical difficulties in this respect would be found to exist. Probably the best plan would be to fill the balloon in a shed, temporarily erected for the purpose. With reference to the fourth requirement, involving the necessity of procuring a balloon that could be steered to a certain extent, he had made experiments, whereof a complete account was rendered to the Royal Academy of Science. The principle of the steering arrangement devised by him consisted in providing the balloon with an adjustable sail and one or more guide ropes, which were allowed to drag on the ground. By means of a steering apparatus of this description he was able to cause his balloon Svea (1,000 cubic meters) to deviate on an average 27° from the direction of the wind. At times the deviation even amounted to 40°. Thus he hoped to have fully shown that the aeronautical engineer was perfectly justified in claiming to be well able to furnish a ballooning outfit that would satisfactorily meet all demands and be entirely suitable for the purpose in question. The chief object of the expedition would be to explore the northern polar regions. The party would leave Europe early in the summer of 1896 in time to reach Norskoarne Islands, situated near the northwest corner of Spitzbergen, by the middle of June. On one of the Norskoarne, or at other suitable place, the balloon shed would be erected. When this was completed the balloon would be filled and everything be made ready to start at a few hours' notice. The balloon should be so balanced that, when free, it would travel at an average height of 250 meters above the surface—i. e., below the lowest clouds, but above the fogs at the surface.

The start was to be made in July, as soon as the weather would permit—i. e., on a clear day when a brisk south or nearly south wind was blowing. It was quite essential that the wind should be brisk and have this direction, in order that the balloon might quickly travel far into the unknown territory and approach the pole. It was chiefly the central portion—i. e., the most inaccessible part—of the polar regions that it should be the aim of the expedition to explore, and the exploration of the boundaries that connected with the portions already known should be made a matter of secondary consideration. Apart from the geographical work, extensive meteorological observations should be carried on and all other data gathered that would be of general interest. Among the instruments necessary for the expedition, he mentioned, in the first place, those needed for making determinations of location and time; further, instruments for determining velocity and altitude and a complete set of meteorological instruments. Finally, the equipment should include a complete photographical outfit. M. Andrée then went on to contend that not only was it possible to cross the Arctic regions by balloon, but that those regions were particularly well suited for balloon voyages.

In the first place, he called attention to the great advantages arising from the fact that the sun at the season when the trip was to be made always remained above the horizon, so that the surrounding landscape was never by darkness kept from the view of the explorers. Another advantage derived from the perpetual sunshine was that the temperatures of the balloon and the air were kept very uniform. Another circumstance in favor of making the Arctic journey by balloon was that the surface passed over was glossy and free from vegetation.

Electrical discharges hardly ever occurred in the Arctic. Neither was there any danger that gales would be encountered, as in July gales appeared to be very rare occurrences. He contended, therefore, that nobody could on good grounds deny that it would be possible by a single successful balloon journey to acquire in a few days greater knowledge of the geographical aspect of the Arctic regions than would otherwise be obtainable in centuries.

Herr Andrée's paper was subjected to severe criticism.

Admiral Markham pointed out that in a balloon they did not really know what was under them. Even if Herr Andrée had the satisfaction of coming back and saying he had been to the North Pole, he would not be able to say where he had been traveling. Then, again, if any accident happened to the balloon, what was he going to do?

Mr. Silva White said he would have thought that no one would in these days have supposed it possible for an inflated bag to be driven against the wind. In order to carry a party of three men and boats and other paraphernalia they would require a balloon of enormous size. Herr Andrée might get to the North Pole, but he would probably have to remain there.

In the course of a vigorous reply to his critics Herr Andrée announced that the whole of the funds required for his expedition had been subscribed within 14 days of his making his proposal public. The president's warmly expressed wishes that Herr Andrée's gallant attempt might prove successful clearly expressed the feelings of the congress.

A GREAT MAP OF THE WORLD.

Among the matters remitted from the Berne congress, that which excited the greatest amount of interest was the proposal associated with the name of Professor Penck, of Vienna, for the construction of a map of the world on a uniform scale of 1:1,000,000. At the Berne meeting the proposel had been very fully discussed, and the general feeling of the congress was unquestionably in favor of the proposal. But there was a certain degree of opposition to the proposal on the ground of the many difficulties it presented. That this feeling has not been wholly conquered during the four years that have elapsed was manifest from the speech of Professor Wagner, of Gottingen, and the applause that it elicited; but the majority of the members felt with Professor Schrader, of Paris, that the existence of great difficulties was not a sufficient reason why the attempt should not be made. Sir Charles Wilson, one of the British members of the international committee appointed at the Berne meeting to further the project, presented a report and a number of recommendations for the acceptance of the congress.

TROPICAL AFRICA AND ITS DEVELOPMENT BY THE WHITE RACES.

The audience which assembled on Wednesday, for the purpose of hearing Sir John Kirk's paper on the extent to which tropical Africa is suited for development by white races or under their superintendence, was perhaps larger than had been attracted by any other subject during the congress.

Sir John Kirk, being called on to read his paper, said that modern knowledge had placed equally at the disposal of all European nations great and powerful agencies, and the subject for discussion was the method by which, in friendly co-operation, those agencies may be brought to bear on the development of Africa—first, with a view to facilitating European colonies where families of white people may remain without marked deterioration to the race; secondly, with a view to the establishment of settlements under European supervision, where the white races might by periods of temporary residence, and without any attempt at colonization properly so called, develop the country with the aid of the native races; and, thirdly, the means by which either, within the sphere of such settlements or beyond their immediate limits, the native races might be conducted in the path of progress, be taught to labor with the object of utilizing to the full the dormant resources of their country, and of exchanging them for the products of civilized countries, so that labor might be economized and made more productive by the employment of such simple agencies as might be found to be best adapted to the purpose. Before any part of tropical Africa could be regarded as the likely home of permanent self-supporting white communities or colonies five conditions must be present: (1) The climate, as expressed chiefly by the diurnal and yearly range of temperature and the moisture in the air, must be approximately that of countries elsewhere near the tropics, as in America, Australia, South Africa, or Southern Europe, where the white races had already been established. (2) Malaria, in the form known as bilious remittent fever, must not be present in an aggravated form. (3) The country, in order to become a European colony, must not only be capable of yielding the necessaries of life to white settlers, but must also contain mineral and other resources sufficient to attract European colonists, and offer to them a fair prospect of making money by industry and energy, and of living in comparative comfort. (4) These conditions must, moreover, extend over an unbroken area of sufficient extent to enable the growth of a population large enough for its own defense. It was also essential that movement from place to place should not be hampered by the necessity of crossing malarial belts where fever might be contracted. (5) Since it was admitted that the maritime zones on either side of the continent were malarial, and that even a temporary detention in these areas was depreciatory of the physique of the European, a rapid means of transit from the coast to the colony by river or rail was essential. Examining each of these conditions seriatim, Sir John Kirk dealt first with climate, the most important of all considerations in the choice of a home for Europeans in Central Africa. The data at our disposal were few and unsatisfactory, but we might at once dismiss as useless for the purpose of real colonization the whole of the maritime zones on both coasts, together with all lands in tropical Africa below a general level of 5,000 feet. Within such areas—which included the greater portion of the vast continent—the temperature everywhere and the humidity in most parts was such as to exhaust the average European constitution after a comparatively short period of residence. But in the higher central and more mountainous regions the climate, both as regards the extremes of temperature and the annual mean, would compare favorably with districts outside the tropics, already successfully occupied by Europeans. The general conclusion was that there were districts in tropical Africa large in themselves, but small in comparison with the continent as a whole, in which climate alone would afford no obstacle to European colonization. On the second point, he said we were at present without reliable data with regard to the presence and distribution of various endemic diseases of a malarious type, especially of that known as "bilious remittent fever" in its various forms. We knew, however, that fever in the healthy uplands was rare, and when it did occur, was of a milder type than in the lowlands. It was, in fact, not of a type which would be in any way an obstacle to European colonization. It must be remembered, however, that the health record of a new country in the early stages of its development was by no means a fair criterion of its eventual adaptability to the purposes of colonization. With regard to the third point, he said it was self-evident that a district, in order to attract European settlers and to induce them to leave countries better suited to their constitutions with the prospect of enduring the privations inevitable to the foundation of homes in remote and isolated parts, must offer some sufficient attraction in the shape of agricultural, pastoral, or mineral products. The country must also be able to produce the ordinary necessaries of European life. The healthy plateaux of Africa were as a rule fertile, and some of them were rich in minerals. It was also essential that the area selected for European colonization should be continuous and of sufficient extent. In healthy districts broken up by unhealthy valleys and feverish belts it would be impossible for residents to escape disease which, once contracted, they might find it difficult to shake off, possibly for years afterward. Elevation alone was therefore no safeguard against malaria. Finally, it was essential that there should be a rapid means of transit from the coast to the colony, which was necessarily at a distance inland and at a considerable elevation. What regions lying within tropical Africa fulfilled the conditions he had laid down? All the possessions on the west coast under Great Britain, Germany, France, Portugal, Spain, and the Congo State (with the possible exception of German Southwest Africa) were throughout their whole extent too malarious, too hot, and too damp to offer a chance of European colonization. Even German Southwest Africa was handicapped by its lack of a convenient port of entry. But in the vast region under British rule, in the same latitude on the east coast, all the conditions necessary for successful colonization were present. The climate compared favorably with districts a little further south, which had already been successfully colonized by Europeans of various nationalities. It was indeed in this district (Southeast Africa) that the first attempts at permanent settlement within the tropics of Africa would be made. Across the Zambesi valley further to the north lay the extensive and elevated plateau which was situated to the west of Lake Nyasa, and extended to the Kafué River. The administration of this country had recently been taken over by the South African Company, but at present we know too little about it to be able to form an accurate judgment. A considerable portion of the district had an average elevation of 7,000 ft., was well watered, easy of access from Lake Nyasa, and, so far as could at present be judged, was likely to be found suitable to European life. There was little doubt that these cool highlands, as also the equally healthy savannas of the Batoka country to the west (north of the Victoria Falls), would be occupied as colonies. Batokaland at present suffered from the presence of the tsetse fly, fatal to horses and cattle, but the scourge had invariably retired before the advance of civilization. The unhealthy Zambesi valley to the south here became extremely narrow, and at one time of the year was easily crossed without danger. The one remaining region in tropical Africa which appeared adapted for colonization was the extensive and elevated plateau and escarpment which formed the greater portion of British East Africa. These uplands varied from 5,000 to 7,000 ft. in height; the climate was cool, and, so far as was known, was very healthy for Europeans. There was yet one other promising district which might not improbably fulfill the conditions requisite for colonization—viz., the mountainous districts of Abyssinia included in the Italian protectorate. This region must, however, be passed over with only a cursory mention, for we had at present no data on which to base conclusions, nor had the country as yet been subjected in any degree to the actual test of experiment. Sir John Kirk then proceeded to point out that European settlement was almost everywhere possible in varying degrees. He thought the superabundance of native labor available should tend to the success of European agricultural, pastoral, or mining enterprise, and this would constitute at once the strength and the danger to the early pioneers.

MR. STANLEY'S SPEECH.

Mr. H. M. Stanley, M.P., who was received with cheers, said he thoroughly agreed with the paper read by Sir John Kirk. It was a wise and an able paper, but he thought it looked too far ahead. Sir John talked about the fitness of Africa for colonization, but so far, in Central Africa he knew no intention to colonize any part of it. He did know, however, of a good many intentions to make the thing possible in the region called Central Africa, in the way of commerce, in the way of improving the blacks, and in the way of making the country fit for colonization in the distant future. Their aims on the Congo were simply to develop the commercial possibilities of that region and prepare the way for those who would exploit the products of Africa. On the Congo now they had something like 40 steamers and 800 white men, where 16 years ago there was not one. Now, if those men had to travel on shank's mare, with all the knowledge of science they might have, he doubted very much whether they would go very far; but, being taken aboard those vast steamers, they could travel thousands of miles north and south, east and west. So now they had the whole of the Congo basin navigated, and this was what they were trying to get the British government to do in British East Africa. When they had completed the railway to Stanley Pool and had got steamers going 15 or 16 knots instead of six or seven, and when they had got telegraph stations they would have done wonders, and by that time they would have carried hotels and all the necessaries of civilization into those regions. (Cheers.) People went to Africa and found that there were no hansom cabs (laughter), that they could not even get a cup of café au lait, that if they offered a thousand pounds for a loaf of white bread they could not get it. They found they had to carry their house and stores on their backs. So they went home at once and condemned Africa. Now that was not the way to look at a great region. (Cheers.) He believed in those lines of Shakespeare,

"All places that the eye of heaven visits
Are to a wise man ports and happy havens."

He believed it from his soul. (Cheers.) India had been the white man's grave, but they found people there who never thought of going over to England. They found people in Brazil who never thought of going to Portugal, their mother country, people in Chile, Peru, and Mexico, who never thought of going to Spain, who had made their homes there and intended to live and die there; and the time would come when the whole of Central Africa, barring the maritime regions, of course, would be in the same position as Mexico and Brazil and Ceylon. (Cheers.) It was the art of living they needed to teach in tropical countries. He had tried to teach young men from England and Scotland how to live in Africa, but he invariably failed, because if one saw one's good advice rejected one got sick and tired of preaching it. He had seen a young fellow who, after going there with a whole souled desire to distinguish himself, walked under the very hottest sun with a black cloth cap he was accustomed to wear in the temperate regions of Scotland. That man never returned to Scotland. He had seen another too fond of the liquor bottle, and he had said: "My dear fellow, you do not need Dutch courage in this country any more than you need it in your own. Take a teaspoonful at night as a nightcap if you want it, but not in the day, when the sun is hot. Take a tabloid of quinine. That will be ever so much better." But those men never returned. He had gone himself seven times into Africa, twice across, and altogether he had been there 23 years, and he felt just as strong to-day as though he had never been there. He mentioned various other cases of men who had lived in Africa for many years and were quite as healthy as when they went to it. At present we were sending young men fresh from the college and from

the university, fresh from their mothers' laps (laughter), into Africa, and they perished almost the first day they found a different atmosphere and a different sun. Before sending these young men into Africa they should go and study for two or three months the various arts of conquering these fevers, warding them off, and living wisely. (Cheers.)

SLATIN PASHA'S SPEECH.

Colonel Slatin Pasha, who met with a most cordial reception, said: "After more than 16 years in Africa, including 11 years of captivity, during which I was cut off from all communication with the civilized world, I have had the good fortune to return to civilization. How Africa has changed within this period! Regions in whose exploration Livingstone, Speke, Grant, Stanley, Cameron, Brazza, Matteucci, Du Chaillu, Von der Decken, Rohlfs, Wissman, Junker, Schweinfurth, Holub, Lenz, and hundreds of others risked their lives are now accessible to civilization. In most of these, in which the explorer had formerly to encounter the greatest dangers, there are now military posts and stations to afford security and facilitate the trade which is constantly becoming more active. From the east, Italy, England, Germany; from the west, the Congo State, France and England, are daily enlarging their sphere of influence, and are now on the point of joining hands in Central Africa. Wild tribes, who in their mode of life are nearer the beast than to man, are beginning to know new wants, beginning to understand that there are beings mentally superior to them, and who through co-operation are unconquerable, even in foreign lands. The more northerly of the still independent Mahometan kingdoms, Wadai, Bornu, and the Fellata kingdoms, are regarding these advancing powers with a view to concluding alliances with some of them, perceiving that only in this way their hereditary rule can be secured. In the middle of Africa, between the lands just mentioned and the advancing powers, lies the former Egyptian Sudan, now under the rule of the Caliph Abdullah, the despotic head of the Mahdists. No European can venture to cross the limits of this land, cut off from civilization, extending in the south along the Nile to Regjaf, and east to west from Kassala to near Wadai. Death or life-long captivity would be his lot. Yet it is only within the short period of ten years that the land has been subjected to this miserable fate. For more than 60 years, since the time of Mohammed Ali, it remained under the rule of Egypt, and was open to civilization. In the chief towns were found Egyptian and European merchants, in Khartum itself the foreign powers had their representatives. Travelers of all nations could pass through the land unharmed, and found protection and help through those representatives. Telegraphs and a regular postal service facilitated intellectual intercourse with the most distant countries. Mahometan mosques, Christian churches, and mission schools looked after the religious and moral education of the young. The land was inhabited by the most diverse tribes, many of which lived in hostility with one another, but were compelled by the severity of the government to keep the peace. Discontent, no doubt, prevailed in the land. Its cause was to be sought in the avarice of the officials, especially of the native Sudanese, who latterly had acquired high positions, and by their oppression and tyranny enriched themselves as quickly as possible, and also in the ignorance of the country on the part of the Europeans, who, often with the best intentions, issued orders directly contrary to the traditions and views of the Sudanese, which could not but excite ill will. Mohammed Akmed knew and took advantage of the mood of the country. Well knowing that only a religious factor could unite the hostile tribes, he maintained that he was the Mahdi sent by God, the deliverer of the country from a foreign yoke, the regenerator of religion. He roused the tribes to war against the government, promised his adherents in case of death the everlasting joys of Heaven, in case of victory four-fifths of the booty to the survivors. Thus were fanaticism and avarice, the two chief qualities of the Sudanese, awakened. The spark grew to a bright flame. Victory after victory was gained by the insurgents. Kordofan fell into their hands. The army sent under Hicks for the reconquest of the land was annihilated, and I was compelled, after long and vain struggles, to surrender. The insurgents marched on Khartum.

On arriving in the neighborhood of that town I had chains put round my neck and feet, since I was suspected of being anxious to make my escape and join General Gordon. The town was besieged. The personal valor and energy of General Gordon were spent in vain in endeavoring to avert the coming calamity. Khartum fell on January 20, and with it the bravest of its defenders, General Gordon himself, who was murdered on the highest steps of his palace. His head was severed from his body and was mockingly shown to me as I lay in irons. The fanatics behaved with fury in the conquered town. Men and women were killed with few exceptions, and the survivors were maltreated and tortured with the most refined cruelty in order to extort from them information as to the place of concealment of property they might have hidden. Only young girls and pretty women were spared—not out of compassion. They did not wish to lose them, nor to torture them, as thus their beauty would have been impaired and their value diminished. They were distributed among the adherents of the Mahdi—among them many Christian women and girls. After the retreat of the English army from Dongola I was permitted, after nearly eight months of captivity, a certain amount of liberty, on condition that I should never leave the Caliph Abdullah ebn Mohammed, and that I should always remain in his immediate neighborhood as his moulazim (body guard). Two circumstances induced me to watch him closely.

As I was the last living military governor, he believed in his entire ignorance of the political conditions of European countires that in case of my escape I should be in a position through my more accurate knowledge of the country to induce the Egyptian or English government to take hostile measures against the Sudan. On the other hand, it flattered his vanity to have as his servant his former master, one to whom most of the western Arab tribes and among them his own allies in blood, the Taascha-Bazara, had been subject. Severe and cruel, he trusted no one and governed despotically, solely according to his own good pleasure. Since he is of the tribe of the Taascha-Bazara (that is the name applied to all the nomadic rearers of horned cattle) and belongs to Darfur, he relies as a stranger in the Nile valley only on his kinsmen by blood, the western Arab tribes, and armed slaves; while he sought to diminish the strength of the native tribes of the Nile valley, the Gjaaliin and Danagla. By disarmament, confiscation of property, executions and the dispatch of those capable of bearing arms against his enemies, so that they might die in battle or through privations, he has so weakened these tribes that they are now compelled to endure his rule. The greater part of them regret that they have been stirred up by fanaticism or on other grounds to rise against the former government.

They now understand that the government has only been changed, that religion served only as a flag, as a means for the attainment of the end desired. They now long for the end of the tragedy which they themselves brought upon the scene. Only after eleven years' captivity did I succeed in gaining my freedom. Although all intercourse with any one was forbidden to me, I was nevertheless in secret relation with tribes of the country formerly known to me. For years, and on several occasions, I had determined on flight, but those participating in my attempts were always deterred by the dangers of the undertaking. At the close of last year I sent a man to Cairo, and through the intervention of the Austrian Consul-General Baron Heidler, and Major Wingate, Director of the Intelligence Department for Egypt, he received the necessary means for my flight out of the money deposited by my relatives.

By means of a large sum secured to him by contract in the event of the success of the undertaking he gained over people to venture their lives in delivering me. On the night of February 20, after the Caliph had gone to rest, I left the town unobserved and reached the camels held in readiness in the steppe. My guides, knowing that they had only a few hours' start, forced their pace. After an unbroken ride of twenty-one hours we had accomplished 180 miles, but the exhausted animals refused to go farther. For six days I remained hidden in the inhospitable Giif Mountains, until my guides, who were Arabs of this district, succeeded in obtaining other camels. At first it had been our intention to make good our escape by traveling as quickly as possible, but now the only chance of success was strategical maneuvering, as all routes were closely watched by the dervishes, who had overtaken us. However, we succeeded in crossing the Nile near Berber, and reaching the Etbai Mountains by a roundabout way. Here my last guide, an old Arab, fell ill, and I was compelled to leave him behind, together with the only camel which was still in my possession.

Now commenced the worst part of the whole journey, as I had to proceed on foot. But the hope of freedom enabled me to overcome all difficulties. On March 16 I left the mountains and reached Assuan, the first settlement of civilized men. My feelings at that moment were indescribable. I was saved from my enemies, from the hands of a fanatical despot, and had left behind me a country governed by absolute and arbitrary tyranny, and separated completely from any civilization. Behind me was the Sudan, where so many Christians are still kept in bonds of slavery and where the greater part of the population prays to God for liberation. I reached Cairo by steamer on March 19. Everywhere I received tokens of the most sincere sympathy with my fate. Standing now here, in the middle of civilized society, again a man among men, my thoughts turn often back to the fanatical barbarians with whom I had to live so long, to my perils and sufferings among them, to the unfortunate companions of my captivity, and to the enslaved nations of those remote territories. My thanks are due to God, whose protecting hand has led me safely through all the perils behind me. (Loud cheers.)

COLORING PAPERS WITH ANTHRACENE DYES.

Now that the anthracene colors are being prepared much more cheaply than the aniline dyes, their use in the manufacture of colored papers is becoming more frequent every day. Their application, however, is a little different to the aniline dyes. They require to be developed, and fixed upon the fiber by means of mordants. The cheapest mordants for fixing the anthracene colors on the pulp in the beating engine are alum, which must be absolutely free from iron, and tartrate of potash. The method of using these is simple. A quantity of potash or ammonia alum, equivalent to 3 per cent. on the weight of dry paper pulp in the engine, is dissolved in hot water, and there is added to this a further quantity of tartrate of potash equal to two-thirds of the weight of the alum. When these salts are dissolved they are poured into the engine. After thoroughly circulating and mixing with the stuff, the required quantity of anthracene color is added. This depends upon the shade or depth of color required, and will vary from ¼ lb. to 5 lb. of color to the 100 pounds of the dry paper stock. In order to develop the color and dye the fiber, the contents of the engine are gradually heated to from 60 to 70° C., which is best done by injecting steam into the mass as it circulates. After the dye has become fixed and the water in the engine clear, the stock may be washed previous to being sized. In this, as in all other matters relating to the dyeing of paper stock, considerable judgment must be exercised by the operator to get the exact shade or tone required, and to fix the whole of the color upon the fibers. In some cases the dyed "stock" may be let down into the draining chests, and then allowed to drain and be partly washed; afterward being transferred in the usual way to the beading engines. In such cases the dyeing can be performed in the breaker. Anthracene dyed stock can be brightened and improved by the addition of small quantities of the anilines.

For coloring paper while running over the machine as in the manufacture of flowered papers the web when still moist is first passed through a trough containing a solution of alum, then through a second trough containing the tartrate of potash, and finally through the third vessel containing the anthracene color. The proportion of color to water is as 1:10. Squeezing rolls are used after each trough, by the aid of which the excess of fluid is pressed from the web. The speed of travel must not be too quick in order to allow sufficient time for the fluids to penetrate the texture of the sheet and to allow the fibers to be properly mordanted and the color to be fixed. Light shades of great brightness can be prepared in this way. In purity and brightness of tone they rival those made from aniline colors.

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